Final Report

for the Period June 30, 1973 to January 1, 1975

Glassy Carbons

February 1975

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ARPA Order No. 1824

Department of Materials and Metallurgical Engineering

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The University of Michigan

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Program Code Number: 1D10
Contractor: The Regents of The University of Michigan
Effective Date of Contract: 1 June 1973
Amount of Contract: $150,000
Contract Number: DAHC15-71-C-0283
Principal Investigator: Professor Edward E. Hucke
Department of Materials & Metallurgical Engineering
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SUMMARY

Through the introduction of a controlled porosity, selectable in the range from below 100A to 50 microns, it was possible to produce glassy carbon in section thickness in excess of 3 inches in processing times less than six days. It was further learned and confirmed through a variety of measurements that glassy carbon is not a single material, even when made from the same starting polymer system, but rather a class of materials whose structure and resulting properties can be tailored over an extremely wide range. The properties obtainable compare favorably not only with other carbons, but with other material classes, especially for high temperature applications.

A new thermodynamic method was developed and applied to quantitatively measure the configurational enthalpy and entropy of various glassy carbons relative to graphite. The measurements confirmed quantitatively the marked differences that exist in the atomic strains and disorder in the different carbons. The thermodynamic measurements also gave a quantitative measure of the fraction of surface sites covered by oxygen, which was found to be higher than for graphite. In addition, the high degree of disorder in glassy carbon was shown to at least partially account for the increased resistance to gasification in $CO-CO_2$ shown at high temperatures by glassy carbons with respect to graphite.

The various carbons have a basically planar structure. The fine structure determined by electron microscopy, electron diffraction and X-ray diffraction is not homogeneous on a size scale below 100 Angstroms. The material is paracrystalline with a characteristic size ranging from 10-100Å depending on processing, and with some non-graphitic, very crystalline regions occasionally existing in sizes up to 500Å.

Helium, xylene, mercury intrusion, small angle X-ray scattering, surface area analysis, and scanning electron microscopy show the pore structure of glassy carbons may be either isolated or interconnected, mono or polydisperse, and in a size range from 5Å to 50 microns. Mechanical strength has an approximate inverse relation to the pore size. The pore structure allows a decrease in density, as well as the opportunity to vary mechanical properties and provide chemical filtering and absorption appliances with substantial strength.

GLASSY CARBONS

I. INTRODUCTION

In the past ten years, various workers have reported the preparation, structure, and properties of a "new" form of carbon called glassy, glass-like or vitreous carbon. The names arose from the similarity in appearance to a black glass. Relatively little was known about its detailed structure.

Since these relatively pure carbons are made from controlled decomposition of various polymers, they represent a potentially plentiful and cheap material which, because of the inherent chemical and physical properties of carbon, offer exciting possibilities, including those for very high temperature applications. These materials are isotropic in properties and easily formed into complicated shapes. The major disadvantage of these materials has been that in order to obtain crack free pieces only very small sections (less than 1/8") could be produced and then only with very long and therefore expensive (e.g. 30 days) pyrolysis cycles. In addition, while the materials studied all had some similarities in properties, enough variation existed to question whether the structure was unique and whether substantial improvement might be made through a better control and understanding of the structure. In order to answer these questions, a three year research program was undertaken at The University of Michigan under the sponsorship of the Advanced

Research Projects Agency of the Department of Defense. Related programs were also carried out at Battelle Northwest Laboratories, Pennsylvania State University and Gulf Energy and Environmental Systems Division.

The major goal of the program at The University of Michigan was to extend the section size available and shorten the pyrolysis cycle. Additional goals were to extend the range of properties obtainable and structurally characterize the materials.

The experimental program had three major areas of endeavor, 1) Materials Preparation, 2) Structural Characterization, and 3) Property Evaluation and Correlation. Many of the detailed findings in each of these areas have already been presented in a series of reports[1-5], and a complete set of experimental data is presented as an appendix to this report. Since the total number of experiments is very large, only a summary of the major findings in each of the areas will be presented in this final report.

II. MATERIALS PREPARATION

The primary goal of the research was realized when it was demonstrated that very thick sections (up to 3 in.) could be produced in relatively short cycles (1 to 6 days) if a pore forming liquid were used with the original polymer in order to help the escape of gas during pyrolysis. Both the total pore volume and the pore size could be in this way reproducibly varied over very wide ranges. Pore size was varied over four orders of magnitude reaching down to the 30-50 angstrom size. Both open and closed pore system materials were produced having in several cases a selectable pore size distribution.

The most important conclusion arising from the materials preparation program was that glassy carbon is not a single material, but rather includes a wide range of materials with a correspondingly large range in properties. Not only do different starting polymers produce different structures when pyrolyzed the same, but in general every aspect of the polymer processing and pyrolysis of a given starting material influences the final product. This finding indicates that a high degree of control is required to make a reproducible property set, but it also indicates the exciting potential to tailor a given set of properties to a desired end use. Both the ability to reproduce and to controllably vary the properties were demonstrated in the many hundreds of carbons prepared in this program.

In general, the polymers that yield glassy carbons are thermosetting, network types that evolve substantial quantities of heat during their polymerization. In general such materials have multiple condensation reactions which depend on temperature as well as amount and type of catalyst. Examples are phenolic and furfural alcohol types which were used most in this work. It was found that the most important factor in obtaining good samples was in carrying out a controlled initial polymerization so that as nearly as possible all parts of the sample were undergoing reaction at the same time and temperature. This requires in general very slow reactions at low temperatures, particularly in larger section sizes. It was found that once having produced a non-uniform polymerization due to, for example, allowing the center of a section to get hotter than the surface, a crack free piece could not be made no matter how slowly the subsequent pyrolysis was carried out. On the other hand, if a uniform micro and macro structure were produced relatively fast pyrolysis cycles were successful.

Aside from yielding crack free samples, the fine structure as measured by a variety of means was different for a given polymer starting material after indentical heating to 2000°C where only the time of holding at 100°C was varied. This finding shows a remarkable ability to inherent structural modifications built in through early processing. The work also indicated that different structures could be obtained by varying only the pyrolysis rate, pressure (vacuum vs. nitrogen), and final heat treating temperature (HTT). The effect is large and well known, the atmosphere and rate effects were more subtle but still present.

III. STRUCTURAL STUDIES

Since it was soon learned that there was no single structure for glassy carbon, it is impossible to summarize the detailed structural findings of all samples. However, several generalizations can be made. First, glassy carbons are not homogeneous, even though they may appear to be on a macroscopic level. All contain significant amounts of porosity which accounts for their very attractive low density. The void space may, however, vary considerably in amount and size, and the solid comprising the remainder of the structure varies significantly in size and structure. Since the structural features of both the solid and the voids vary over such a wide size range, there is, in general, no single evaluation technique that can be used. As a result, this program used all of the techniques available with cross comparisons where such were possible.

Solid Structure

The solid structure was studied using X-ray diffraction, electron microscopy and diffraction, optical microscopy, and a specially developed thermodynamic analysis.

X-ray Studies - The various carbons have received relatively active study by wide angle X-ray diffraction. In general, this work agreed well with the previous works. However, within the usually reported range of values for the layer plane spacing, d_{002}; the in plane spacing, d_{110}, and the line broadening parameters, L_c and L_a, there is an experimentally significant variation depending on the particular carbon and its processing. In short, while this method is rapid, and can determine easily the difference between disordered carbons and relatively good graphite, it is very insensitive to the differences between highly disordered carbons. The complete findings are presented in Table 1 of the Appendix. The important findings are that increasing HTT and some processing methods, which in general could not be predicted, resulted in materials that had X-ray structures significantly closer to graphite, although they were never very close to being a fully developed graphitic structure. The structure is certainly planar, with a near perfect graphitic spacing within planes. The line broadening parameters, L_c and L_a, are certainly not easily interpreted in this case as crystallite sizes, but they do correspond within a factor of about 2 with features that can be seen in electron diffraction and transmission microscopy.

Electron Microscopy and Diffraction - Transmission electron microscopy, both bright and dark field, together with selected area diffraction studies shed some light on the fine structure of the carbons. These results are summarized in Tables 2 and 3 in the Appendix. They show that on a small scale, 20-100Å, most of the material is highly disordered giving at most a granulated appearance and very poor crystallinity. The granulation makes up a larger structure which often appears to be platelets of 100-500Å. Occasionally structural features from 1000-10,000Å were encountered, which gave a well defined graphitic or a crystalline indication of one of the tetrahedrally bonded carbon polymorphs. This behavior has been noted in other studies of glassy carbon[6]. The various structures could be approximately correlated with the X-ray data, were roughly as expected with varying HTT, but in general important and unexplainable differences occurred between different processing treatments on the same polymer.

Thermodyanmic Studies - Since the various methods of studying the fine scale solid structure were not very sensitive to small differences, an entirely new method was conceived, developed and applied. This method measured the free energy difference between a macroscopic sample of the disordered carbon and nearly perfect graphite, as a function of temperature, using a solid electrolyte cell. A traditional thermodynamic analysis, together with the known fact that the specific heats of the carbon differed negligibly, allowed the calculation of residual (configurational) entropy and enthalpy values. These values are, respectively, direct numerical measures of the degree of disorder relative to graphite and the amount of bond straining and missing bonds relative to graphite. The values measured were quite large (10 cal/mole-°K) compared to those for other paracrystalline materials such as polymers. Various glassy carbons showed large difference in each parameter even though no such large differences were noticeable in the other structural measurements. In general this method proved highly satisfactory, and is recommended as a tool in characterizing various samples of disordered carbons since its greatest sensitivity occurs at the highly disordered states. It is noteworthy that various samples can have a highly strained structure on a microscale (high residual enthalpy), but have a relatively low disorder (low residual entropy). The reverse was also found to be true, although higher entropy is usually associated with higher enthalpy. No simple models of small relatively perfect crystals or randomly stacked crystals could account for the relatively high residual entropies measured. A mixed bond model was developed that could semi-qualitatively rationalize this result.

It was also found that the measurements on a given carbon could be used with literature data for oxygen exchange to give quantitative information about the oxygen occupation of surface reaction sites. This technique is a potentially valuable new tool for studying the surface structure of various carbons.

The remarkably high entropy values associated with some glassy carbons accounts for its unusual stability at high temperatures where the entropy term in the free energy outweighs the enthalpy term. In fact, this finding was demonstrated in an independent experiment described below.

Stability of Glassy Carbon and Graphite in CO_2 - Most of the commercially available and the experimental samples of glassy carbon prepared at The University of Michigan, exhibited at high temperature, equilibrium oxygen partial pressures higher than graphite. The equilibrium oxygen partial pressure, p_{O_2}, increased with increasing temperature for all the glassy carbon samples. Table 4 lists the p_{O_2} values at three temperatures for a commercial graphite UC-AGSR, one commercially available sample of glassy carbon (Beckwith D-82-2), and three experimental samples. The samples (except for graphite which was heat treated to 2500°C) were heat treated to about 2000°C for about one hour in the atmosphere of either flowing nitrogen or vacuum ($\approx 5\times 10^{-7}$ atms.). The values of p_{O_2} for all the samples tabulated in Table 4 are higher than for graphite. For example, p_{O_2} value for Hercules H-54 sample at 1200°C is roughly four orders of magnitude higher than graphite at the same temperature. This big difference in p_{O_2} naturally suggests an interesting experiment; let samples of glassy carbon and graphite be placed side by side at a high temperature and then pass a $CO-CO_2$ gas mixture, which is oxidizing to graphite and reducing to glassy carbon, over the two carbon samples, i.e.,

$$\left(p_{O_2}\right)_{\text{graphite}} < \left(p_{O_2}\right)_{CO-CO_2\ \text{mixture}} < \left(p_{O_2}\right)_{\text{glassy carbon}}$$

If the kinetic factors are favorable, and if the desired $CO-CO_2$ gas mixture maintains constant p_{O_2} within the limits of the above inequality, then all of the graphite sample should be oxidized, except ash, and the glassy carbon sample should undergo negligible weight loss.

An experimental program was designed with the above motive. The Beckwith D-82-2 and LMSC glassy carbon samples were studied. Unfortunately, the thermodynamic data and hence p_{O_2} values were not measured for LMSC glassy carbon samples, but to a first approximation they can be assumed to be close to that of Beckwith D-82-2 sample. About 2 gms comprising 10-15 thin equivalent chips of both graphite and glassy carbon (to avoid any surface area effects) were weighed and placed in zirconium boats side by side in the constant temperature zone of a horizontal furnace. The CO_2 gas was passed through graphite chips kept at gas entry portions of a lower temperature zone of the same furnace, and the resulting $CO-CO_2$ gas mixture then continuously flowed over the boats containing graphite and glassy carbon samples kept at the desired constant temperature zone, and then flowed out of the system. The temperature of the graphite chips at the lower temperature and the temperature of the constant temperature zone were adjusted in such a fashion that the resulting $CO-CO_2$ gas mixture satisfied the desired inequality of Eq. 1.

The weight loss data are shown in Table 5, where temperature and time refer to the temperature and time of gas flow at the constant temperature zone. The furnace was cooled without the flow of CO_2 to avoid any sooting on carbon samples. The weight loss ratios of graphite and glassy carbons are as high as 19, but not infinite as anticipated by theory discussed above. However, the net weight losses of glassy carbon samples are very small, about 30 milligrams in 2 grams, and this could well be either experimental error or due to some CO_2 gas which might have passed through the low temperature graphite bed without coming to its equilibrium. It should be noted that the glassy carbon loss was small and about constant even though the flow rate varied by 1 order of magnitude, the time varied by a factor of 6, and the temperature varied by 300°C. The dramatic effect of CO_2 gas flow rate on graphite oxidation as opposed to almost invariance for glassy carbon is quite apparent from Table 5. For examples, a flow rate of 0.6 c.c./sec. at 1200°C for 45 minutes oxidizes 22.7% of graphite, whereas a flow rate of 0.05 c.c./sec. for even 12 hours at about the same temperature, oxidizes only 2.3 percent of the same graphite sample. The probable reasons for only partial oxidation of graphite are short constant temperature zone, relatively low CO_2 flow rate, and a need for better control of the inequality of Eq. 1. It would appear possible through further refinement of this experiment to demonstrate unequivocally that the differences in weight loss were not due to kinetic factors.

These preliminary results suggest strongly that the well known high temperature oxidation resistance of glassy carbon relative to graphite can be explained at least partially by its higher equilibrium oxygen pressure, as well as the more usual explanation on the basis of kinetic factors.

Pore Structure

Small Angle X-ray Scattering - The fine pore structure on the scale of 10-100Å was studied using small angle X-ray scattering. Table 6 summarizes the radius of gyration values observed using a traditional analysis. Since the pores are probably not spherical, a pore diameter has not been reported. For the most part these data are in agreement with those in the literature. They show pores ranging from 15 to 100A with the lower values associated with lower HTT. However, a significant new finding was evident. In many of the carbons the pore size is polydisperse. A controlled variation of the dispersion would be useful in tailoring properties, particularly in chemical absorption and catalysis.

Scanning Electron Microscopy - For pore structure ranging from 100Å up, scanning microscopy was used. It was found that good checks with other methods, such as porosimetry and transmission electron studies, were possible in certain ranges where they overlapped. By varying the resin, its polymerization, and pyrolysis, it was possible to vary not only the amount of pores, but the shape and size distribution. With these techniques it becomes possible to tailor a strong body with a controlled pore structure for subsequent infiltration with other materials as, for example, metals. It was also found possible to allow a macro pore structure to connect the smaller pore structure as might be required in chemical applications.

Pycnometry - The very fine scale porosity was studied using He or Xylene pycnometry. The results are given in Table 9. In light of the purposeful inclusion of porosity, it is not surprising that the apparent density of the carbons could be varied over the wide range indicated. However, it was also noted that the real density shows considerable variation (1.18 to 1.9 gm/cm^3). Such a large variation had not previously been shown. It was found that even the "real density" of the various carbons was illusive since different values were often obtained in He and Xylene. In general, the Xylene densities were most reproducible and were, together with the geometrically determined apparent densities, the basis for normalizing all the physical properties for the fraction solid contained. It was found that there was no explainable correlation of the real density with processing variables.

Surface Area - These data are summarized in Table 7. For the most part the data were obtained with gas (N_2) absorption, but some measurements were made in a Knudsen flow apparatus. The surface area figures could be well correlated with that visible in the scanning electron microscope (∿100A resolution) except in the cases for low HTT carbons. In this case, a very large amount of assessible surface exists, probably on the scale of 5-10A, as has been noted by studies of chemical sieving. Many of the samples exhibit useful surface areas large enough (>500 m^2/gm) to be attractive in chemical operations, particularly when it is noted that the materials are quite strong and easily made into macroporous coherent form.

Mercury Porosimetry - Another check for the pore properties was provided by Hg intrusion. The results shown in Table 8 in general agree with those found by other methods. The table shows a few examples of the remarkably wide range available in tailoring pore structure. For example, the pore volume of those samples measured ranged from .02-1.1 cm^3/gm, and the mean pore diameter from 30-470,000Å. The pore spectrum could be made either very narrow or varied over a wide range. The real density, as measured with Hg, shows only moderately good agreement with that measured with He or Xylene.

IV. PROPERTY EVALUATION

Hardness

Obtaining a meaningful hardness test on carbons has long been realized to be difficult due to the large amount of voids usually present and the relatively low modulus. In most of the materials the indentation recovers completely after removing the load. Application of a coating to the surface allows a reading of the indentation that exists under load, which is relatively large due to the porosity and low modulus. Using this value, the hardnesses were rarely over 300 VHN. However, these materials easily scratch hardened steel and glass, which would indicate their hardness should be in excess of 1000 VHN. While various hardness tests were studied, it was concluded that many were useful only in comparing properties of carbons with closely related structures, and not for comparison with different material classes.

Compressive and Tensile Strength - After development of testing techniques, it was found that compressive testing gave the most reproducible strength results. The values, which are averages for multiple samples for both compressive and tensile strength, are tabulated in Table 9 and in Table 10 on a normalized basis. After trials of several methods for measuring tensile strength, the diametral loading of a right cylinder was chosen. This test was quite consistant with tensile bar data. The values shown for both tension and compression are for samples with a larger stressed volume than those most often published for three-point bending of very small samples. The values shown are useful for comparing the various kinds of carbon, but since they are brittle materials, should be used with care in comparing to other sample sizes, testing speeds, etc. Values up to about 60,000 psi compressive and 11,000 psi tensile were produced. There is no reason to believe that either of these values represented an optimum. It should also be noted that most of the samples had a purposefully included porosity, even though often it was too fine to see with anything except an electron microscope. Therefore, the strengths shown are quite attractive compared to other material classes on a density normalized basis. The comparison of properties also looks promising with respect to graphitic materials. The physical properties were also corrected to the actual fraction of carbon as determined by the ratio of apparent to real density. It can be seen in Table 10 that these values still show a wide range for the various carbons. This indicates that structural factors dominate the strength. As might be expected, a rough correlation was obtained between the strength and the size of the pores. The strengths are roughly inversely proportional to the logarithm of the pore size[3]. However, even at a given pore size and volume, some of the carbons were significantly stronger which indicates that the very fine scale structure of the solids plays a role. This conclusion was supported by a correlation that was established between the reduced compressive strength and the reduced electrical conductivity.[5]

<u>Sonic Modulus and Internal Friction</u> - The sonic modulus agreed well with that determined in tensile testing and was therefore adopted for routine evaluation. The data are included in Tables 9 and 10. These data show a possibility for selecting a

modulus over a range of more than 1 order of magnitude. This factor can be extremely useful in designing with other materials in order to minimize thermal stresses and stress concentrations. The range encompasses that for various human bones, which is of particular significance in biomaterials applications, where these carbons are known to have the required bio-compatibility. The modulus, when corrected for the fraction carbon present, should be relatively independent of ordinary micro-structural features such as pore size or shape. However, the normalized data which range from $.3\times10^6$ to 10^7 psi indicate substantial differences exist in the short range bonding in the different carbons. The higher value is more than three times the usual value for glassy carbon, but well below that for various carbon fibers. However, since the materials are isotropic, they indeed look attractive with respect to other carbon materials. In addition, on a strength to density basis, they compare favorably with all other classes of materials. The modulus for a given carbon tends to go through a maximum versus HTT in the range 1000-1800°C. A similar effect was detected in strength values. It should be emphasized that the values thus far determined do not represent the optimum.

The internal friction behavior was determined on a variety of carbons and found to encompass a range spanning the whole range of other material classes from the highly damping to the almost loss free. This factor again indicates the ability to tailor properties to a given requirement. Since the pore structure, as well as the fine scale bonding, would be expected to affect the internal friction, no clear-cut correlation was found with other measured properties.

Resistivity - The electrical resistivity data are included in Tables 9 and 10. It can be seen that values range widely for the various carbons. On a normalized basis there is, as expected, a much smaller variation, but still more than a factor of three when comparing materials with the same HTT. It is therefore certain that the processing affects the short range bonding, but in no easily predictable manner. When comparing materials processed to the same HTT, those with the lower reduced resistivity, showed the highest values of strength on a reduced basis. However, since the resistivity for a given material falls continuously versus HTT, and the strength in general goes through a maximum, reduced resistivity can not be used as a sole yardstick for strength.

References

1. E. E. Hucke, "Glassy Carbons," Semi-Annual Progress Report, January 1972, ARPA Contract No. DAHC15-71-C-0283.

2. Ibid, June 1972.

3. Ibid, January 1973.

4. Ibid, June 1973.

5. Ibid, January 1974.

6. A. G. Whitacre and B. Tooper, "Single Crystal Diffraction Patterns From Vitreous Carbon," Aerospace Report No. TR-007 4(9250-07)-2, May 15, 1974. National Technical Information Service No. AD 778-933.

APPENDIX

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TABLE 1 SUMMARY OF X-RAY DATA

(All values in Angstroms)

Symbols Used in the Tables

Experimental Condition

All the samples were run in a Phillips-Norelco Diffractometer using CuKα radiation under the following conditions:

Tube Voltage: 45KV
Tube Current: 14mA
Proportional Counter Voltage: 1.622KV
Proportional Counter Time Constant: 4 sec.
Chart Speed: 1/2 inch/min.
Scan Speed: 1.2 degree (2θ)/min.
Slits: 1°/006"/1° at Primary/Scattering/Secondary

Sample used of thickness of 3mm in all cases except where otherwise designated. The value of d(10) refers to the unresolved (100) and (101) peak.

(002) Peak Type

S: "Smooth" (or single phase) Peak
NVS: "Not Very Smooth" Peak
2P: "2 Phase" Peak
3P: "3 Phase" Peak

Sample Designation	Temp. (°C)	(002) Peak Type	d(002)	Lc	d(10)	La
Graphite, solid 3mm & 1mm thick		S	3.37	Very High	2.13	Very High
Graphite		S	3.37	Very High	2.13	Very High
Graphite, natural (Reported)		S	3.35	Very High	2.13	Very High
Graphite, synthetic (Reported)		S	3.37	Very High	2.13	Very High

Sample Designation	Temp. (°C)	(002) Peak Type	d(002)	Lc	d(10)	La
Commercial Samples						
Lockheed, solid	2000	S	3.53	21.2	2.09	98.0
Lockheed, reported	2000		3.56	19.0	--	--
Beckwith, solid	2000	S	3.55	23.2	2.09	112.0
Beckwith, reported	2000		3.54	15.0	--	50.0
Tokai, solid	1000	S	3.70	14.2	2.07	43.7
Tokai, reported	2000		--	--	--	--
Atomergic Chemicals Co., V-25, solid	2500	S	3.40	38.4	2.09	69.0
Atomergic Chemicals Co., V-25, reported	2500					
Atomergic Chemicals Co., V-10	1000	NVS	3.44	42.0	2.10	71.0
Atomergic Chemicals Co., V-10, reported	1000		--	--	--	--
Hercules H-54	1795	S	3.49	28.0	2.09	51.0
311-9	2000	S	3.54	28.0	2.10	57.0
311-19	700	S	3.63	18.0	--	--
311-20	2000	S	3.53	27.2	2.10	46.0
311-21	2000	S	3.52	27.2	2.10	54.0
311-22	2000	2P	2.49 3.45	29.0	2.12	>125.0
311-25	700	S	3.70	21.0	--	--
311-30A	2000	S	3.51	23.4	2.10	54.0
311-31	2000	S	3.50	25.0	2.10	51.0
312-8	2000	S	3.52	27.0	2.10	42.0
312-9	2000	2P	3.52 3.45	27.0	2.10	57.0
312-10	700	S	3.65	16.2	--	--
312-10	2000	S	3.49	35.0	2.11	53.0
312-14	2000	S	3.51	29.0	2.09	61.0
312-14A	2000	3P	3.46 3.43 3.36	32.0	2.12	>150.0
312-15	2000	S	3.52	27.1	2.11	51.0
312-16	2000	3P	3.47 3.43 3.36	32.1	2.11	51.0
312-21	2000	S	3.51	30.8	2.10	57.0
312-26	2000	S	3.51	27.8	2.09	48.0
312-28	2000	S	3.51	27.2	2.10	51.0
312-29	2000	S	3.51	34.0	2.10	57.0
312-31, solid	2000	S	3.57	27.6	2.10	56.0
312-32	2000	S	3.51	30.8	2.10	54.0
312-33	2000	NVS	3.48	30.8	2.10	52.8

Sample Designation	Temp. (°C)	(002) Peak Type	d(002)	Lc	d(10)	La
312-34	2000	2P	3.46 3.44	33.0	2.11	46.2
312-39	2000	S	3.49	29.8	2.10	53.0
312-40	2000	2P	3.48 3.45	30.1	2.09	54.0
312-43	2000	2P	3.48 3.43	33.2	2.11	51.0
312-44	2000	2P	3.48 3.44	42.0	2.11	51.0
312-48	2000	3P	3.46 3.43 3.37	30.4	2.10	37.0
312-49	2000	S	3.52	31.1	2.11	61.0
315-1	2000	S	3.53	27.2	2.10	48.0
315-2	2000	2P	3.49 3.43	29.0	2.10	54.0
315-3	700	S	3.71	16.2	--	--
315-5	2000	2P	3.49 3.44	29.0	2.11	54.0
315-8	2000	2P	3.49 3.44	28.2	2.10	56.0
315-9	2000	2P	3.47 3.44	33.0	2.11	47.0
315-14	2000	S	3.53	26.3	2.10	54.0
315-18	2000	3P	3.40 3.382 3.351	45.0	--	--
315-20	680	S	3.70	16.3	--	--
315-20A	2000	2P	3.53 3.43	28.0	2.10	57.0
315-21C	2000	2P	3.52 3.43	27.8	2.10	57.0
315-22	665	S	3.67	16.4	--	--
315-22	2000	S	3.52	28.0	2.10	51.0
315-24A	2000	2P	3.47 3.38	20.0	--	--
315-25A	2000	S	3.52	26.5	2.09	48.0
315-26B	2000	3P	3.50 3.41 3.37	26.5	2.10	46.0
315-26C	680	S	3.69	17.1	--	--
315-28	2000	2P	3.52 3.43	26.0	2.10	46.0
315-28B	600	S	3.70	16.8	--	--
315-30	2000	2P	3.56 3.43	24.0	2.09	48.0
315-31	680	S	3.70	18.2	--	--
315-34	680	S	3.69	15.4	--	--

Sample Designation	Temp. (°C)	(002) Peak Type	d(002)	Lc	d(10)	La
315-36	2000	3P	3.52	24.3	2.10	48.5
			3.43			
			3.37			
315-37	680	S	3.63	17.5	--	--
315-37	2000	S	3.50	26.3	2.098	42.0
315-38	680	S	3.63	18.8	--	--
315-38	2000	2P	3.49	27.1	2.097	46.0
			3.43			
315-39	2000	2P	3.53	27.2	2.098	57.0
			3.43			
315-39	680	S	3.63	20.0	--	--
315-40	2000	S	3.54	25.6	2.097	51.0
315-41	2000	NVS	3.49	23.6	2.098	51.0
315-42	2000	S	3.56	27.2	2.098	46.0
315-43	2000	NVS	3.52	24.3	2.098	51.0
315-43	700	S	3.67	17.4	--	--
315-44	2000	2P	3.55	23.1	2.10	40.2
			3.45			
315-45	2000	S	3.49	27.2	2.10	46.6
315-46A	2000	2P	3.55	23.1	2.098	57.0
			3.43			
316-6	2000	NVS	3.50	27.0	2.11	57.0
316-7, Run 1	2000	S	3.49	28.0	2.10	45.0
316-7, Run 2	2000	S	3.52	27.0	2.10	53.0
316-15	2000	2P	3.40	32.0	--	--
316-28	2000	S	3.50	27.2	2.10	51.0
316-32	2000	2P	3.42	53.0	--	--
			3.40			
317-1	700	S	3.71	20.0	--	--
317-1	2000	S	3.46	45.0	2.11	63.0
317-2	700	S	3.68	15.7	--	--
317-2	2000	NVS	3.48	24.6	2.09	47.0
317-6	700	S	3.71	13.0	--	--
317-6	2000	NVS	3.55	22.0	2.10	55.0
317-7	700	S	3.68	16.0	--	--
317-7	2000	NVS	3.46	27.5	2.10	50.0
317-8	700	S	3.71	11.5	--	--
317-8	2000	2P	3.56	20.0	2.10	44.0
			3.46			
317-10	2000	NVS	3.48	26.0	2.10	68.0
317-11	700	S	3.71	16.3	--	--
317-13	700	S	3.72	15.0	--	--
317-13	2000	NVS	3.47	24.0	2.08	66.0
317-14	700	S	3.71	15.7	--	--
317-14	2000	NVS	3.45	27.0	2.09	46.0
317-15	700	S	3.71	15.3	--	--
317-15	2000	NVS	3.47	26.0	2.09	54.0
317-16	2000	S	3.54	24.0	2.09	53.0

Sample Designation	Temp. (°C)	(002) Peak Type	d(002)	Lc	d(10)	La
317-18	2000	S	3.59	21.0	2.09	58.0
317-19	700	S	3.68	16.5	--	--
317-19	2000	NVS	3.49	30.0	2.09	52.0
317-20	700	S	3.66	17.5	--	--
317-20	2000	S	3.50	25.6	2.09	48.0
317-24, Run 1	2000	NVS	3.52	24.0	2.09	45.0
317-24, Run 2, solid	2000	NVS	3.49	21.0	2.09	50.0
317-25	2000	S	3.53	20.0	2.09	50.0
317-26, Run 1	2000	NVS	3.48	26.0	2.09	48.0
317-26, Run 2, solid	2000	2P	3.46 3.43	24.2	2.10	51.0
317-28	2000	NVS	3.46	25.0	2.09	52.0
317-29	700	2P	3.43 3.42	21.5	--	--
317-29, Run 1	2000	NVS	3.43	65.0	--	--
317-29, Run 2	2000	NVS	3.426	75.0	--	--
317-30	2000	2P	3.44 3.40	29.5	--	--
317-31A	2000	S	3.58	22.0	2.10	46.0
317-32	700	S	--	--	--	--
317-32	2000	2P	3.51 3.48	23.6	2.08	49.0
317-33	700	S	3.68	17.0	--	--
317-33	2000	S	3.414	92.0	2.10	49.0
317-34	700	S	3.68	17.0	--	--
317-34	2000	3P	3.44 3.42 3.36	30.0	2.09	50.0
317-35	700	S	3.71	16.0	--	--
317-35	2000	3P	3.50 3.43 3.36	26.5	2.10	62.0
317-37	700	S	3.68	15.6	--	--
317-37	2000	NVS	3.43	43.0	2.10	63.0
317-38	700	S	3.68	15.6	--	--
317-38	2000	3P	3.54 3.43 3.37	25.0	2.09	51.0
317-39, Run 1	2000	3P	3.45 3.43 3.36	28.0	2.10	52.0
317-39, Run 2, solid, 1mm thick	2000	3P	3.52 3.42 3.37	24.2	2.09	45.0
317-39, Run 3, solid, 1mm thick	2000	3P	3.52 3.41 3.37	23.5	2.09	49.0

Sample Designation	Temp. (°C)	(002) Peak Type	d(002)	Lc	d(10)	La
317-40	2000	3P	3.49	24.8	2.10	48.0
			3.42			
			3.36			
317-41A	2000	S	3.53	26.5	2.10	48.0
317-41B	2000	S	3.53	28.0	2.10	54.0
317-42	2000	3P	3.49	26.0	2.10	42.6
			3.42			
			3.36			
317-43	2000	3P	3.45	26.0	2.09	56.0
			3.42			
			3.35			
317-44	2000	3P	3.48	30.0	2.09	55.0
			3.42			
			3.36			
317-45, solid, 1mm thick	700	S	3.75	12.9	--	--
317-45, Run 1	2000	3P	3.48	25.0	2.09	60.0
			3.40			
			3.35			
317-45, Run 2	2000	3P	3.46	24.0	2.09	42.0
			3.42			
			3.35			
317-46	2000	3P	3.43	31.5	2.10	75.0
			3.42			
			3.36			
317-47	2000	3P	3.50	27.0	2.10	60.0
			3.42			
			3.36			
317-48, Run 1	700	S	3.71	16.2	--	--
317-48, Run 2	700	S	3.87	17.4	--	--
317-48, Run 1	2000	3P	3.45	40.0	2.10	60.0
			3.43			
			3.37			
317-48, Run 2 solid, 1mm thick	2000	3P	3.46	34.0	2.10	59.0
			3.43			
			3.37			
317-49	700	S	3.71	15.7	--	--
317-49, Run 1	2000	3P	3.49	29.0	2.09	62.0
			3.41			
			3.35			
317-49, Run 2 solid, 1mm thick	2000	3P	3.46	33.0	2.09	60.0
			3.44			
			3.37			
317-50	700	S	3.67	15.6	--	--
318-1	2000	S	3.55	28.0	2.10	54.0
318-2	2000	S	3.51	27.0	2.10	55.0
318-3, Run 1	700	S	3.70	16.7	--	--
318-3, Run 2	700	S	3.69	16.7	--	--

Sample Designation	Temp. (°C)	(002) Peak Type	d(002)	Lc	d(10)	La
318-3	2000	2P	3.46	26.0	2.11	51.0
			3.41			
318-4	700	S	3.66	16.8	--	--
318-6A	2000	S	3.50	31.0	2.09	59.0
318-7, Run 1	2000	S	3.50	28.0	2.10	65.0
318-7, Run 2, solid	2000	S	3.49	28.0	2.10	45.0
318-8, Run 1	2000	S	3.45	39.0	2.10	63.0
318-8, Run 2 solid, 2mm thick	2000	S	3.45	43.5	2.10	77.0
318-9	2000	2P	3.48	32.5	2.11	57.0
			3.46			
318-10	520	S	3.74	15.2	--	--
318-10	2000	S	3.49	33.8	2.12	50.0
318-11, Run 1	2000	NVS	3.42	77.0	2.10	38.0
318-11, Run 2	2000	NVS	3.43	78.0	2.11	40.0
318-12	2000	3P	3.49	31.4	2.09	59.0
			3.43			
			3.36			
318-13	2000	NVS	3.42	44.0	2.10	58.0
318-14	700	S	3.65	16.0	--	--
318-14	2000	3P	3.48	30.5	2.10	60.0
			3.43			
			3.36			
318-15, Run 1	700	S	3.75	16.0	--	--
318-15, Run 2	700	S	3.75	15.1	--	--
318-15	2000	3P	3.45	30.2	2.10	60.0
			3.42			
			3.37			
318-16	700	S	3.72	15.7	--	--
318-16	2000	2P	3.43	39.0	2.09	49.0
			3.41			
318-17	700	S	3.68	16.7	--	--
318-17	2000	NVS	3.45	42.0	2.11	59.0
318-18, Run 1	700	S	3.68	16.4	--	--
318-18, Run 2	700	S	3.71	16.3	--	--
318-18	2000	S	3.55	25.6	2.10	44.0
318-19	2000	S	3.52	26.0	2.09	59.0
318-20	700	S	3.67	16.0	--	--
318-20	2000	S	3.53	21.0	2.09	48.0
318-21, Run 1	700	S	3.78	14.0	--	--
318-21, Run 2	700	S	3.75	15.4	--	--
318-21	2000	S	3.55	23.6	2.10	55.0
318-22	700	S	3.70	15.4	--	--
318-22, Run 1	2000	NVS	3.44	65.0	2.10	55.0
318-22, Run 2	2000	NVS	3.44	64.0	2.11	54.0
318-23	700	S	3.74	16.0	--	--
318-23	2000	S	3.63	63.0	2.10	73.0
318-24	700	S	3.64	16.7	--	--

Sample Designation	Temp. (°C)	(002) Peak Type	d(002)	Lc	d(10)	La
318-24	2000	S	3.44	45.0	2.10	68.0
318-26, Run 1	700	S	3.69	15.7	--	--
318-26, Run 2	700	S	3.75	16.1	--	--
318-26, Run 3	700	S	3.69	16.7	--	--
318-27	2000	2P	3.45 3.41	35.4	2.10	47.0
318-28	700	S	3.75	18.0	--	--
318-28	2000	2P	3.47 3.42	27.0	--	--
318-29, Run 1	2000	NVS	3.45	30.0	2.08	62.0
318-29, Run 2, solid, 1mm thick	2000	2P	3.50 3.44	30.5	2.10	65.0
318-29, Run 3	2000	2P	3.52 3.42	31.0	2.10	60.0
318-30	700	S	3.64	15.2	--	--
318-30, Run 1	2000	2P	3.48 3.43	34.1	2.11	69.0
318-30, Run 2	2000	3P	3.45 3.41 3.36	31.0	2.11	63.0
318-31, Run 1	2000	2P	3.45 3.43	35.5	2.10	64.0
318-31, Run 2	2000	3P	3.47 3.41 3.36	31.0	2.11	63.0
318-32, Run 1	700	S	3.64	15.7	--	--
318-32, Run 2	700	S	3.63	16.0	--	--
318-32	2000	S	3.44	47.0	2.10	65.0
318-33	700	S	3.66	16.7	--	--
318-33	2000	NVS	3.46	28.0	2.11	64.0
318-34	700	S	3.63	16.5	--	--
318-34	2000	3P	3.49 3.43 3.36	37.0	2.10	59.0
318-35	700	S	3.71	15.3	--	--
318-35	2000	3P	3.50 3.44 3.37	34.0	2.11	67.0
318-36	700	S	3.68	17.0	--	--
318-36	2000	2P	3.51 3.44	28.0	2.10	49.0
318-37	700	S	3.71	16.1	--	--
318-37	2000	3P	3.46 3.43 3.376	33.6	2.10	52.0
318-38	700	S	3.71	15.6	--	--
318-38	2000	3P	3.47 3.43 3.37	28.0	2.10	49.0

Sample Designation	Temp. (°C)	(002) Peak Type	d(002)	Lc	d(10)	La
318-39, Run 1	700	S	3.71	17.0	--	--
318-39, Run 2	700	S	3.65	17.2	--	--
solid, 1mm thick						
318-39	2000	S	3.51	26.1	2.09	60.0
318-40	700	S	3.71	15.0	--	--
318-40	2000	2P	3.52 3.45	28.0	2.11	54.0
318-41	700	S	3.71	14.8	--	--
318-41	2000	S	3.50	28.0	2.09	57.0
318-43, Run 1	700	S	3.69	17.0	--	--
318-43, Run 2	700	S	3.71	13.8	--	--
solid, 1mm thick						
318-43, solid	2000	S	3.44	31.0	2.12	58.0
318-44	700	S	3.72	15.6	--	--
318-44	2000	S	3.55	27.2	2.10	44.0
318-45	700	S	3.71	15.7	--	--
318-45	2000	S	3.56	25.4	2.10	46.0
318-46	700	S	3.71	15.9	--	--
318-46, solid 1mm thick	2000	S	3.53	26.2	2.11	51.0
318-47	700	S	3.71	15.0	--	--
318-47	2000	NVS	3.49	29.0	2.10	48.0
318-48, Run 1	2000	S	3.53	26.8	2.10	54.0
318-48, Run 2	2000	S	3.52	29.2	2.10	42.0
318-50, Run 1	700	S	3.71	14.3	--	--
318-50, Run 2	700	S	3.71	15.5	--	--
318-50	2000	S	3.53	26.0	2.10	46.0
318-51	2000	S	3.56	27.2	2.10	56.0
318-52	2000	S	3.53	26.5	2.10	54.0
318-53, Run 1	2000	S	3.52	26.5	2.10	54.0
318-53, Run 2	2000	S	3.54	30.0	2.10	60.0
318-54	700	S	3.66	17.0	--	--
318-55	700	S	3.71	15.2	--	--
318-56	2000	S	3.54	27.0	2.10	54.0
318-58	700	S	3.71	18.0	--	--
318-58	2000	NVS	3.51	28.2	2.10	51.0
318-59	700	S	3.68	16.7	--	--
318-59	2000	S	3.51	26.0	--	--
318-60	700	S	3.70	15.7	--	--
318-60	2000	2P	3.47 3.44	32.0	--	--
318-61	700	S	3.71	18.6	--	--
318-61	2000	S	3.52	23.3	2.09	55.0
318-62	700	S	3.70	15.3	--	--
318-62	2000	S	3.56	22.5	2.10	51.0
321-1	700	S	3.66	5.0	--	--
321-2	700	2P	3.63 3.57	17.4	--	--

Sample Designation	Temp. (°C)	(002) Peak Type	d(002)	Lc	d(10)	La
321-2	2000	3P	3.54 3.43 3.38	22.8	2.10	51.5
321-3	700	S	3.64	17.4	--	--
321-3	2000	S	3.53	24.3	2.10	51.0
321-4	700	S	3.64	17.2	--	--
321-4	2000	-	--	--	--	--
321-5	700	S	3.63	15.4	--	--
321-5	2000	S	3.49	26.4	2.09	53.7
321-6	700	S	3.64	17.0	--	--
321-6	2000	S	3.54	27.7	2.10	48.0
321-7	700	S	3.69	18.0	--	--
321-7	2000	-	--	--	--	--
321-8	700	S	3.69	17.5	--	--
321-8	2000	-	--	--	--	--
321-9	700	S	3.67	17.4	--	--
321-9	2000	-	--	--	--	--
321-10	700	S	3.67	17.0	--	--
321-10	2000	-	--	--	--	--
321-11	700	S	3.71	17.0	--	--
321-11	2000	2P	3.54 3.46	27.2	2.10	65.0
321-12	700	S	3.63	16.8	--	--
321-12	2000	S	3.53	26.4	2.094	56.0
321-13	700	S	3.66	17.0	--	--
321-13	2000	2P	3.49 3.42	33.2	2.09	61.0
321-16A	2000	3P	3.50 3.43 3.36	30.8	2.10	57.0
321-16B	2000	S	3.50	28.8	2.10	44.0
321-16C	700	S	3.63	15.2	--	--
321-17	700	S	3.60	18.7	--	--
321-17B	2000	S	3.49	28.8	2.10	44.0
321-18A	2000	3P	3.50 3.43 3.37	29.8	2.10	49.0
321-18B	700	S	3.63	15.2	--	--
321-19A	2000	2P	3.54 3.426	25.0	2.09	46.0
321-19A	700	S	3.63	17.1	--	--
321-19B	2000	NVS	3.43	39.0	2.10	53.8
321-20A	700	S	3.63	17.5	--	--
321-20A	2000	3P	3.52 3.42 3.36	28.0	2.10	61.0
321-20B	2000	3P	3.53 3.426 3.37	37.0	2.10	46.0
321-21A	700	S	3.63	18.0	--	--

Sample Designation	Temp. (°C)	(002) Peak Type	d(002)	Lc	d(10)	La
321-21A	2000	NVS	3.43	41.6	2.10	51.0
321-21B	700	S	3.64	18.4	--	--
321-21B	2000	S	3.52	27.0	2.10	57.0
321-22A	2000	2P	3.52 3.43	27.6	2.10	53.0
321-22B	700	S	3.70	16.1	--	--
321-23	2000	S	3.49	33.0	2.10	54.0
321-23A	700	S	3.63	18.4	--	--
321-23B	700	S	3.36	16.5	--	--
321-23B	2000	3P	3.52 3.43 3.36	29.6	2.10	51.0
321-24	700	S	3.70	15.8	--	--
321-24A	700	S	3.63	16.2	--	--
321-24B	700	S	3.63	16.5	--	--
321-24B	2000	S	3.43	35.4	2.09	57.0
321-25	700	S	3.63	18.4	--	--
321-25	2000	NVS	3.47	30.8	2.10	60.8
321-25A	700	S	3.60	21.0	--	--
321-25A	2000	NVS	3.43	40.2	2.10	60.5
321-26	700	S	3.67	15.0	--	--
321-26	2000	S	3.52	27.2	2.094	48.5
321-26A	700	S	3.63	18.1	--	--
321-26A	2000	S	3.52	27.2	2.094	54.0
321-27	2000	S	3.52	29.8	2.10	51.0
321-29	700	S	3.63	16.8	--	--
321-29	2000	3P	3.49 3.40 3.35	24.8	2.094	58.0
321-30	700	S	3.63	19.6	--	--
321-31	2300	3P	3.44 3.41 3.37	49.0	2.10	60.5
321-31A	2300	NVS	3.40	90.0	2.11	58.0
321-31B	2300	3P	3.49 3.43 3.37	37.0	2.11	69.0
321-31C	700	S	3.60	18.8	--	--
321-31C	2300	3P	3.49 3.426 3.37	34.5	2.11	69.0
321-31D	700	S	3.63	17.4	--	--
321-31D	2300	S	3.47	37.2	2.11	69.0
321-31E	700	S	3.63	17.4	--	--
321-31E	2300	NVS	3.426	61.6	2.11	69.0
321-31F	700	S	3.60	18.5	--	--
321-31F	2300	S	3.45	44.0	2.10	69.0
321-31G	2300	2P	3.47 3.43	35.0	2.10	56.0

Sample Designation	Temp. (°C)	(002) Peak Type	d(002)	Lc	d(10)	La
321-31I	2300	2P	3.49	40.0	2.11	69.0
			3.38			
321-32	700	S	3.60	18.9	--	--
321-34	2300	S	3.42	57.5	2.10	78.5
321-34A	2300	S	3.426	51.4	2.10	42.0
321-36A	2300	S	3.47	53.6	2.11	64.5
321-36B	700	S	3.63	18.2	--	--
321-36C	2300	S	3.43	70.0	2.10	46.0
321-37	2000	S	3.52	30.8	2.10	54.0
321-37A	700	S	3.60	18.1	--	--
321-37B	2000	3P	3.53	27.2	2.10	54.0
			3.44			
			3.36			
321-38B	700	S	3.63	17.7	--	--
321-39	2000	2P	3.48	34.1	2.10	57.0
			3.426			
321-39B	700	S	3.63	16.4	--	--
321-41C	2000	3P	3.49	32.6	2.10	62.5
			3.43			
			3.36			
321-42A	700	S	3.63	18.8	--	--
321-42A	2000	2P	3.49	35.5	2.10	60.5
			3.43			
321-42B	700	S	3.63	16.7	--	--
321-42B	2000	2P	3.50	25.3	2.10	64.4
			3.43			
321-43B	700	S	3.63	19.3	--	--
321-43B	2000	2P	3.49	35.0	2.098	59.4
			3.42			
321-43B$_1$	2000	2P	3.50	36.8	2.11	59.5
			3.426			
321-43B$_2$	2000	2P	3.50	33.0	2.10	57.0
			3.43			
321-44A	2000	3P	3.50	30.8	2.10	51.0
			3.43			
			3.36			
321-44B	2000	3P	3.50	29.0	2.10	54.0
			3.43			
			3.36			
321-45A	2200	S	3.49	33.0	2.10	57.0
321-45B	2200	S	3.47	45.5	2.10	40.5
321-46A	2000	2P	3.49	31.7	2.10	60.4
			3.43			
321-46B	2000	3P	3.46	30.8	2.10	51.0
			3.43			
			3.36			
321-46C	2000	3P	3.47	35.6	2.10	51.0
			3.43			
			3.36			

Sample Designation	Temp. (°C)	(002) Peak Type	d(002)	Lc	d(10)	La
321-46D	2000	3P	3.50 3.43 3.36	31.7	2.10	64.4
321-48A	2000	S	3.50	31.8	2.10	57.0
321-48B	2000	S	3.50	33.0	2.10	64.4
321-48C	2000	S	3.50	33.0	2.10	60.4
321-49A	2000	S	3.49	33.0	2.10	60.4
321-49B	2000	NVS	3.426	51.2	2.10	54.0
321-51	2000	NVS	3.43	91.5	2.11	69.0
321-51A	2000	NVS	3.43	107.5	2.11	68.0
321-52	2000	NVS	3.43	91.2	2.11	60.5
322-1A	2000	3P	3.44 3.37 3.33	26.4	2.085	57.3
322-1B	2000	S	3.40	41.5	2.085	--
322-2B	1600	S	3.50	23.0	2.085	37.3
322-3B	1600	S	3.53	22.0	2.085	61.0
322-9A	2000	S	3.37	105.0	2.10	49.6
322-9B	2000	S	3.38	117.0	2.09	51.0
322-10A	2000	2P	3.43 3.38	33.0	2.085	--
322-10B	2000	2P	3.50 3.43	30.8	2.10	69.0
322-10C	2000	2P	3.49 3.43	33.4	2.085	--
322-10D	2000	2P	3.50 3.43	28.6	2.10	60.0
322-11A	1670	S	3.55	22.0	2.085	51.2
322-11B	1670	S	3.49	23.0	2.085	47.0
322-11B	2000	2P	3.47	33.0	2.085	48.5
322-12A	1600	S	3.56	23.0	2.085	40.5
322-12B	1670	S	3.56	22.0	2.10	57.0
322-13B	1670	S	3.53	31.8	2.085	50.2
322-14A	1670	S	3.50	23.0	2.085	--
322-14B	1670	S	3.56	21.0	2.09	46.0
322-15B	1670	S	3.56	25.0	2.085	48.4
322-16A	1670	S	3.56	23.5	2.085	--
322-16B	1670	S	3.56	22.0	2.085	44.0
322-17A	1670	S	3.56	22.2	2.085	88.0
322-17B	1670	S	3.56	22.0	2.085	51.4
322-18B	1670	S	3.50	28.8	2.085	61.5
322-19B	1670	S	3.56	20.6	2.085	48.5
322-20	1670	S	3.50	21.4	2.085	30.2
322-21B	1670	S	3.56	17.0	2.085	69.5
322-23A	1300	S	3.56	17.4	2.085	--
322-25A	1410	S	3.56	18.5	2.085	46.1
322-25B	1410	S	3.56	19.2	2.07	121.0
322-26A	1410	S	3.50	25.6	2.085	51.0
322-26B	1410	S	3.50	19.2	2.085	40.2

Sample Designation	Temp. (°C)	(002) Peak Type	d(002)	Lc	d(10)	La
322-27A	1410	S	3.59	20.0	2.085	57.3
322-27B	1410	S	3.56	19.3	2.085	--
322-28A	1410	S	3.56	19.4	2.08	40.2
322-28B	1410	S	3.56	17.8	2.085	53.2
322-29	1410	S	3.56	20.1	2.085	40.2
322-29B	1410	S	3.56	21.0	2.085	53.2
322-31A	1410	S	3.56	23.0	2.085	40.4
322-31B	1410	S	3.56	18.8	2.085	54.0
322-32	1350	S	3.56	18.2	2.085	48.5
322-34	1350	S	3.56	19.2	2.085	46.0
322-35	1350	S	3.56	20.6	2.085	54.0
322-36	1543	S	3.56	19.2	2.085	53.0
322-37	1543	S	3.56	23.0	2.085	--
322-40	1440	S	3.53	23.6	2.085	66.0
322-41	1440	S	3.56	20.4	2.085	61.0
322-42A	1440	S	3.56	21.4	2.085	37.1
322-42B	1440	S	3.56	21.4	2.085	65.0
322-46	1440	S	3.53	19.6	2.08	--
322-47A	1440	S	3.50	21.5	2.085	74.0
322-47B	1440	S	3.56	20.0	2.085	51.6
322-48A	1600	S	3.49	21.5	2.085	51.0
322-49	1460	S	3.53	24.4	2.10	49.0
322-49	1600	S	3.52	23.0	2.085	--
322-53A	1460	S	3.56	20.0	2.09	54.2
322-53B	1460	S	3.56	20.0	2.10	--
322-53C	1460	S	3.56	18.4	2.085	49.0
322-54A	1460	S	3.56	18.7	2.085	48.2
322-58	1500	NVS	3.50	21.0	2.085	53.0
322-58A	1500	S	3.49	21.0	2.085	51.0
322-59	1500	S	3.56	24.4	2.085	53.8
322-61	1500	NVS	3.47	37.0	2.09	60.0
322-62	1500	S	3.47	30.8	2.085	97.0
322-62A	700	S	3.56	18.3	--	--
322-63A	1500	S	3.46	35.6	2.10	72.5
322-63	1500	NVS	3.42	31.6	2.10	51.0
322-64	1370	S	3.56	18.5	2.085	54.0
322-66	1370	S	3.56	19.8	2.085	46.0
322-67A	1370	S	3.53	23.0	2.085	53.0
322-67B	1370	S	3.56	20.8	2.085	49.0
322-68A	1370	S	3.56	19.5	2.085	48.0
322-68B	1370	S	3.56	19.6	2.09	51.0
322-69	1370	S	3.56	18.5	2.085	54.0
323-1	1370	S	3.60	18.4	2.08	40.5
323-2	1370	S	3.60	18.4	2.07	44.0
323-2A	1370	S	3.60	18.4	2.07	48.0
323-3	1370	S	3.49	23.0	2.07	51.0
323-3A	1370	S	3.56	19.4	2.08	46.0
323-4	1370	S	3.58	18.9	2.07	54.0
323-4A	1370	S	3.58	20.0	2.07	51.0

Sample Designation	Temp. (°C)	(002) Peak Type	d(002)	Lc	d(10)	La
323-5	1000	S	3.63	16.4	2.07	42.0
323-5A	1000	S	3.63	15.4	2.07	46.0
323-6A	1000	S	3.63	16.8	2.07	42.0
323-6	1000	S	3.63	16.0	2.07	51.0
323-7	1000	S	3.63	18.1	2.07	46.0
323-8	1000	S	3.63	18.4	2.07	44.0
323-8A	1000	S	3.63	17.2	2.07	36.0
323-9	1000	S	3.63	15.6	2.07	44.5
323-9A	1000	S	3.63	16.4	2.07	37.0
323-11A	1000	S	3.63	16.2	2.07	35.0
323-11B	1000	S	3.63	17.7	2.07	37.2
323-11C	1000	S	3.63	17.4	2.07	32.0
323-11D	1000	S	3.63	16.4	2.08	37.2
323-11E	1000	S	3.63	16.7	2.07	39.0
323-11F	1000	S	3.63	16.4	2.07	49.0
323-11G	1000	S	3.63	17.7	2.07	46.0
323-12	1000	S	3.63	17.7	2.07	44.0
323-12A	1000	S	3.63	17.7	2.07	37.0
323-13	1000	S	3.63	18.8	2.07	40.5
323-13A	1000	S	3.63	17.0	2.07	51.0
323-14	1000	S	3.62	16.7	2.08	48.5
323-19	1049	S	3.63	17.7	2.07	37.2
323-20	1049	S	3.63	17.1	2.07	40.5
323-20A	1049	S	3.63	16.8	2.07	51.0
323-21	1049	S	3.63	15.6	2.07	42.0
323-22	1049	S	3.63	16.2	2.07	40.5
323-23	1049	S	3.63	16.5	2.08	51.0
323-24	1049	S	3.63	19.1	2.07	38.6
323-25	1038	S	3.63	16.2	2.07	39.0
323-25A	1038	S	3.63	16.0	2.07	39.0
323-26A	1038	S	3.63	16.2	2.08	42.0
323-26B	1038	S	3.67	16.0	2.08	39.0
323-27	1038	S	3.63	15.5	2.07	42.0
323-27A	1038	S	3.63	16.2	2.08	46.0
323-28	1038	S	3.63	15.0	2.08	40.5
323-29(low-p)	1038	S	3.63	15.8	2.08	44.0
323-29(hi-p)	1038	S	3.62	16.8	2.08	40.4
323-29	1038	S	3.67	16.2	2.08	46.0
323-29A	1038	S	3.63	17.4	2.08	44.0
323-30B	1038	S	3.63	17.1	2.07	56.0
323-30C	1038	S	3.63	15.8	2.08	48.5
323-31	1038	S	3.63	21.0	2.08	46.0
323-32	1038	S	3.63	15.6	2.07	42.0
323-32A	1038	S	3.67	16.5	2.08	38.6
323-32B	1038	S	3.67	16.0	2.08	42.0
323-32C	1038	S	3.63	15.6	2.08	42.0
323-32D	1038	S	3.67	16.7	2.08	44.0
323-33	1027	S	3.63	15.0	2.07	38.5
323-34	1038	S	3.63	16.5	2.08	38.6

Sample Designation	Temp. (°C)	(002) Peak Type	d(002)	Lc	d(10)	La
323-35	1027	S	3.67	15.0	2.08	39.0
323-36	1027	S	3.67	15.0	2.08	39.0
323-36	1027	S	3.63	15.0	2.08	40.0
323-38	1027	S	3.67	15.7	2.08	37.4
323-39	700	S	3.70	14.5	--	--
323-40	1000	S	3.70	15.7	2.08	38.0
323-41	1015	S	3.70	16.0	2.08	40.5
323-42	700	S	3.70	16.0	--	--
323-43	1015	S	3.70	15.4	2.08	40.5
323-45	1015	S	3.70	17.9	2.08	43.0
323-46	1000	S	3.70	15.0	2.08	40.5
323-47	1005	S	3.70	15.8	2.08	42.0
323-48	1005	S	3.70	16.0	2.08	42.0
323-49	700	S	3.70	16.0	--	--
323-50	1000	S	3.70	16.0	2.08	42.0
323-51	1000	S	3.67	16.4	2.08	36.0
323-52	700	S	3.70	15.6	--	--
323-53	1080	S	3.62	18.9	2.08	40.5
323-54	700	S	3.63	16.7	--	--
323-55	1027	S	3.63	15.0	2.08	39.0
323-56	700	S	3.70	15.6	--	--
323-57	1000	S	3.63	16.0	2.08	41.0
323-58	1000	S	3.67	15.7	2.08	36.0
323-59	1000	S	3.67	16.0	2.08	40.5
323-58	1080	S	3.63	15.6	2.08	36.0
323-64	700	S	3.63	16.2	2.08	35.0
323-66	1000	S	3.70	15.0	2.08	48.5
323-67	1000	S	3.63	15.0	2.08	36.0
323-68	1000	S	3.70	16.0	2.07	55.0
323-69	1000	S	3.63	16.2	2.08	46.0
324-1	1000	S	3.70	14.0	2.08	39.0
324-2	1000	S	3.67	16.0	2.08	42.0
324-3	1000	S	3.63	16.2	2.08	42.0
324-4	1000	S	3.63	16.8	2.08	38.0
324-5	1000	S	3.67	15.5	2.08	39.0
324-6	1000	S	3.63	16.2	2.08	38.0
324-8	1000	S	3.67	16.4	2.08	37.4
324-9	1000	S	3.67	14.8	2.08	44.0
324-10	1000	S	3.63	16.5	2.08	36.0
324-11	1000	S	3.63	16.5	2.08	41.0
324-13	1000	S	3.63	16.7	2.08	41.0
324-14	1000	S	3.63	16.4	2.08	42.0
324-15	1000	S	3.63	16.0	2.08	42.0
324-16	1000	S	3.63	16.2	2.08	43.0
324-18	1000	S	3.70	16.2	2.08	60.0
324-19 1 hr. vac.	1066	S	3.63	16.5	2.08	40.0
324-19 1 hr. vac.	1550	S	3.63	18.8	2.08	51.0
324-19	1000	S	3.63	15.9	2.07	35.8

Sample Designation	Temp. (°C)	(002) Peak Type	d(002)	Lc	d(10)	La
324-19 1 hr. vac.	1250	S	3.63	15.4	2.07	35.8
324-19 1 hr. vac.	1890	S	3.56	22.4	2.08	57.0
324-20	1060	S	3.63	16.2	2.08	43.0
324-21	1060	S	3.63	15.9	2.08	44.0
324-22	1060	S	3.70	16.0	2.07	40.5
324-23	1060	S	3.70	16.2	2.08	45.0
324-24	1060	S	3.70	16.2	2.08	40.0
324-25A	1060	S	3.70	16.8	2.08	46.0
324-25B	1060	S	3.67	16.7	2.08	41.0
324-25C	1060	S	3.70	16.0	2.08	42.0
324-27D	1060	S	3.70	16.3	2.08	36.0
324-28	1060	S	3.70	15.3	2.07	38.0
324-29	1060	S	3.70	16.0	2.08	40.0
324-30	1060	S	3.70	15.7	2.08	36.0
324-31	1060	S	3.63	16.4	2.08	39.0
324-33G	1082	S	3.63	17.0	2.08	41.0
324-34	1066	S	3.63	16.0	2.08	37.0
324-35	1066	S	3.63	16.4	2.08	37.4
324-36	1066	S	3.63	17.3	2.08	35.6
324-37	1060	S	3.63	16.4	2.08	37.0
324-38	1066	S	3.63	17.0	2.08	41.0
324-39	1066	S	3.63	16.7	2.08	41.0
324-40	1066	S	3.63	15.5	2.08	39.0
324-40A	1066	S	3.63	16.7	2.08	39.0
324-41	1066	S	3.63	16.5	2.08	42.0
324-42	1066	S	3.63	16.7	2.08	44.0
324-43	1066	S	3.63	16.7	2.08	41.0
324-43B$_4$	1440	S	3.60	22.0	2.08	46.0
324-44	1066	S	3.63	16.5	2.08	46.0
324-45	1060	S	3.63	15.3	2.08	39.0
324-47	1066	S	3.63	16.7	2.08	37.4
324-48	1066	S	3.63	15.9	2.08	41.0
324-49	1104	S	3.63	15.6	2.08	42.0
324-51	1104	S	3.67	15.8	2.08	41.0
324-52	1104	S	3.63	17.4	2.07	48.0
324-53	590	S	3.70	14.4	--	--
324-54	1066	S	3.63	15.0	2.08	39.0
324-56	1066	S	3.63	15.0	2.08	42.0
324-58	1066	S	3.63	15.0	2.08	39.0
324-59	1066	S	3.63	16.0	2.08	49.0
324-61	1066	S	3.63	16.0	2.08	37.0
324-62	1066	S	3.63	15.6	2.08	44.0
324-63	1066	S	3.67	16.0	2.08	40.5
324-65	1066	S	3.63	16.5	2.08	39.0
324-66	1066	S	3.63	16.5	2.08	46.0

TABLE 2 Sizes of the Structural Features Observed in Bright and Dark Field Electron Micrographs Compared to Crystallite Sizes Obtained from X-ray Analysis

Sample #	Platelet Dia. Å	Granulation* Dia. Å	Dark Field Dia. Å** (002)	Dark Field Dia. Å** (100)	X-ray Lc	(Å) La	(002) Peak Type
311-19(2000)	150-500	30-40	20-40	--	--	--	--
311-19(750)[x]	150-350	20-30	--	--	14	19	S
312-31(2000)	200-500	20-45	20-45	--	27.6	56	S
312-31(2000)	150	35	30	>100	28	56	S
317-24(2000)	250	42	60†	--	24	45	NVS
317-29(2000)	>250	60	30-70†	--	65-75	--	NVS
317-33(2000)	250-500	35	--	--	92	49	S
317-45(2000)	>500	30	--	--	25	60	3P
317-48(2000)[x]	250	55	--	--	34	59	3P
317-49(2000)[x]	250-500	45	40†	--	33	60	3P
318-12(2000)	250-500	60	50	110†	31	59	3P
318-22(2000)	>500	40-60	35	--	65	55	NVS
318-22(700)	250	--	--	--	15.7	--	S
318-23(2000)	250	50	50	--	63	73	S
318-23(700)	--	--	--	--	16	--	S
318-29(2000)[x]	>500	30-40	60	--	31	63	2P
321-31C(2000)[x]	250	35	60	80	35	69	3P
321-31D(2300)	250	40	35	80	37	69	S

*Diameter corresponds to distances between nearest neighbor.

**Diameter of diffracting regions obtained from (002) or (100) diffraction halos.

†Some of the crystallites giving rise to halos or spots are very large in size, i.e., up to 500Å.

[x]A second structural feature was observed in the bright field micrographs of these samples. This new feature appeared to be long regular cylinders 500Å in diameter by about 1μ long. Regular striations along the length were spaced 45Å apart.

TABLE 3 Electron Diffraction Results Compared to X-ray Diffraction Results for d(002) and d(10) Spacings (Å)

	X-ray		Electron Diffraction		(002)
Sample #	d(002)	d(10)	d(002)	d(10)	Peak Type
Graphite	3.35	2.13	3.37	2.12	--
311-19(2000)	3.56	2.17	3.45	2.09	--
311-19(750)	3.70	2.19	--	2.07	S
312-31(2000)	3.54	2.12	3.53	2.16	S
	3.57	2.10	3.53†	2.12	S
317-24(2000)	3.50	2.10	3.53†	2.10†	NVS
317-29(2000)	3.43	--	3.35† 3.45	2.12	NVS
317-33(2000)	3.414	2.10	3.35†	2.10	S
317-45(2000)	3.35 3.48	2.09	3.50	2.10	3P
317-48(2000)	3.46	2.10	3.48†	2.12	3P
317-49(2000)	3.48	2.09	3.48†	2.10	3P
318-12(2000)	3.49	2.09	3.47†	2.11	3P
318-22(2000)	3.44	2.10	3.37†	2.07	NVS
318-22(700)	3.70	--	3.50 3.42†	2.11	S
318-23(2000)	3.43	2.10	3.50†	2.10	S
318-23(700)	3.74	--	--	2.07	S
318-29(2000)	3.45	2.08	3.45	2.12	2P
321-31C(2300)	3.43	2.11	3.56†	2.12	3P
321-31D(2300)	3.47	2.11	3.50*	2.125	S

*In this sample no spots were seen on any diffraction halo.
†In addition to Debye-Scherrer rings, a number of sharp diffracting spots were observed on or close to the ring.

Table 4. Oxygen Partial Pressures in Equilibrium with Graphite and Glassy Carbons

Sample Number	Sample Description (HTT, HTt atmosphere)	p_{O_2} (atms) (800°C)	p_{O_2} (atms) (1000°C)	p_{O_2} (atms) (1200°C)
Graphite	UC-AGSR	7.3×10^{-21}	5.2×10^{-19}	9.9×10^{-18}
321-13	1800°C 1 hr vacuum	2.0×10^{-20}	2.8×10^{-18}	8.0×10^{-17}
Beckwith D-82-2	2000°C	5.6×10^{-19}	2.4×10^{-16}	1.0×10^{-14}
Hercules H-54	1795°C 1 hr vacuum	1.4×10^{-18}	7.5×10^{-16}	3.4×10^{-14}
324-19	1890°C 1 hr vacuum	1.9×10^{-19}	2.8×10^{-17}	5.8×10^{-16}

Table 5. Summary of Weight Loss Experiment Data

Sample Description	Temp. (°C)	Time (hr)	Flow Rate of CO_2 (c.c./sec.)	% wt. loss in graphite (UC-AGSR)	% wt. loss in glassy carbon
LMSC Glassy Carbon HTT=2000°C	1200	3/4	0.6	22.7	1.2
LMSC Glassy Carbon HTT=2000°C	1250	3	0.2	20.0	2.0
Beckwith D-82-2 HTT=2000°C	950	3/4	0.2	14.0	2.6
Beckwith D-82-2 HTT=2000°C	1000	1	0.1	2.3	1.5
Beckwith D-82-2 HTT=2000°C	1250	12	0.05	2.3	1.5

Table 6. Radius of Gyration Results from Small Angle X-Ray Diffraction

Commercial Sample #	Our Value R_G (Å)	Reported Value R_G (Å)	Dispersity
LMSC-20	14.8	13.2	Monodisperse
LMSC-26	12.6	----	"
LMSC-30	26.0	23.4	"
GC-10	5.2	5.7	"
GC-20	9.2	9.5	"
V-25	13.9	15.5	"
Beckwith-20	10.8	----	"
V-10-42	14.8	----	"
PFA-2000	13.1	13.0	"
H-54	12.2		"
Our Sample #			
311-19(750)	5.0-65		Polydisperse
312-10(2000)	19.7-53		"
312-31(2000)	14.2-65		"
315-22(2000)	12.0-70		"
317-24(2000)	10.2-70		
317-26(2000)	15.6		Monodisperse
317-45(700)	4.0-90		Polydisperse
317-45(2000)	14.8		Monodisperse
317-48(700)	5.0-85		Polydisperse
317-48(2000)	10.5-66		"
317-49(2000)	12.6		Monodisperse
318-1(2000)	11.8		"
318-3(2000)	15.1		"
318-4(700)	6.0-20		Polydisperse
318-5A(2000)	16.4		Monodisperse
318-6A(2000)	11.5		"
318-7(2000)	16.3		"
318-8(2000)	14.2-63		Polydisperse
318-9(2000)	15.8-75		"
318-10(520)	13.8-45		"
318-10(2000)	14.4-35		"
318-11(2000)	13.2		Monodisperse
318-12(2000)	15.7-75		Polydisperse
318-13(2000)	12.9-68		"
318-14(2000)	12.7		Monodisperse
318-15(700)	6.7-90		Polydisperse
318-15(2000)	13.2-52		"
318-16(2000)	14.1-45		"
318-17(2000)	15.8-46		"
318-18(2000)	11.9-50		"
318-19(2000)	11.8		Monodisperse
318-20(2000)	11.8-50		Polydisperse

Our Sample #	Our Value R_G (Å)	Dispersity
318-21(2000)	12.7	Monodisperse
318-22(700)	10.4-82	Polydisperse
318-22(2000)	15.0-68	"
318-23(2000)	14.0-60	"
318-24(2000)	16.2-85	"
318-27(2000)	14.2	Monodisperse
318-28(700)	6.2-100	Polydisperse
318-28(2000)	12.7	Monodisperse
318-29(2000)	13.0	"
318-30(700)	7.3-63	Polydisperse
318-30(2000)	13.4	Monodisperse
318-31(2000)	13.8	"
318-32(2000)	14.2-70	Polydisperse
318-33(2000)	15.1-58	"
318-34(2000)	13.9	Monodisperse
318-35(700)	8.6-85	Polydisperse
318-35(2000)	12.0	Monodisperse
318-38(2000)	12.0-47	Polydisperse
318-39(700)	13.2-45	"
318-39(1000)	12.4-36	"
318-40(2000)	11.9	Monodisperse
318-41(2000)	15.8-61	Polydisperse
318-42(2000)	12.7-74	"
318-43(700)	13.9-57	"
318-43(2000)	14.4-47	"
318-44(2000)	12.6-52	"
318-45(700)	7.0-46	"
318-45(2000)	20.4-53	"
318-46(2000)	14.0-40	"
318-47(2000)	10.1	Monodisperse
318-48(2000)	10.0-66	Polydisperse
318-49(2000)	10.0-67	"
318-50(700)	7.5-93	"
318-51(2000)	12.9	Monodisperse
318-52(2000)	10.4	"
318-53(2000)	11.3	"
318-56(2000)	10.4	"
318-58(2000)	12.4-85	Polydisperse
318-59(2000)	11.6-76	"
318-60(2000)	10.9-60	"
318-61(2000)	11.2-100	"
318-62(2000)	12.6-70	"
321-2(700)	14.7-52	"
321-7(1795)	11.1-62	"
321-7(2000)	11.7-53	"
321-9(2000)	15.1-57	"
321-10(2000)	15.3-59	"
321-13(1066)	6.85-42	"

Our Sample #	Our Value R_G (Å)	Dispersity
321-13(1227)	8.9-52	Polydisperse
321-13(1504)	9.0-56	"
321-13(1795)	12.0-59	"
321-13(2000)	12.3-66	"
321-23(2000)	12.6-59	"
321-23A(2000)	13.5-69	"
321-23B(2000)	13.2-62	"
321-24(2000)	14.2-79	"
321-24A(2000)	16.4-63	"
321-25(2000)	14.2-72	"
321-31(700)	11.6-65	"
321-31G(2300)	18.1	Monodisperse
323-50(1000)	5.1-70	Polydisperse
324-19(1000)	8.25-76	"
324-19(1250)	9.5-76	"
324-19(1550)	10.5-90	"
324-19(1890)	10.9-93	"

TABLE 7

Sample #	Temp.°C	He Density (gm/cm^3)	Surface Area Knudsen Flow (m^2/gm)	Specific Surface Area (m^2/gm)
311-32	2000	1.41	3.0	26.4
317-9	700	1.83	--	506.0
317-9	2000	1.70	12.5	59.9
317-12	700	1.80	9.1	510.0
317-12	2000	1.72	--	109.0
318-22	700	1.79	--	459.0
318-22	2000	1.51	--	49.6
321-9	700	1.46	--	541.2
321-9	2000	1.28X*	--	12.7
321-13	367	--	--	257.0
321-13	700	--	--	852.3
321-13	1066	1.56X	--	72.4
321-13	1227	1.54X	--	56.6
321-13	1504	1.50X	--	51.3
321-13	1795	1.44X	--	47.9
321-24B	2000	1.48X	--	61.3
321-25A	2000	1.45X	--	36.9
323-8	1000	1.51X	--	3.3
323-26A	1038	1.46X	--	--
323-50	1000	1.51X	--	203.0

*X indicated Xylene

TABLE 8

Sample #	Temp.°C	ρ_{He} real[1] (g/cc)	ρ_{Hg} real[2] (g/cc)	ρ_{Hg} app. (g/cc)	MPD (μ)	IPV (cc/g)
GC No.1		1.47	1.482	1.424	.003	.0273
302-5	2320	--	1.509	.647	2.97	.8828
302-12	2320	--	1.501	.559	3.62	1.1224
305-6	2000	1.94	1.802	.636	2.54	1.0151
6.62 Mo						
305-12	2000	1.55	1.562	.557	4.19	1.1560
305-18	2000	1.77	1.718	.606	2.49	1.0678
.4 Mo						
308P-2 #2		1.586	1.505	1.034	.009	.3030
308P-3 #3		1.611	1.486	1.077	.008	.2559
310-1	1000	1.27	1.446	.814	.023	.5411
310-3	1000	--	1.424	.805	.020	.5454
310-17A	2000	1.50	1.175	.639	.119	.7130
310-18	1000	1.48	1.452	.687	.039	.7666
310-18	2000	1.15	1.366	.648	.044	.8110
310-20	2000	1.09	1.458	1.029	.009	.2855
310-29	2000	1.89	1.533	.944	.014	.3959
311-21	2000	1.59	1.339	.731	.038	.6221
311-22	2000	1.00	.847	.484	.154	.8809
312-19A	730	1.20	1.481	.879	.629	.4626
312-29	728	1.52	1.441	1.038	.014	.2709
312-31	2000	1.41	1.490	.923	.025	.4118
312-45	2000	1.26	1.302	1.214	.005	.0540
312-48	2000	1.53	1.392	.861	.121	.4425
312-49	2000	1.34	1.404	1.031	.011	.2579
315-1	2000	1.50	1.431	.962	47.0	.3412
317-5	2000	1.42	1.313	.873	.071	.4039
317-18	2000	1.50	1.255	.953	39.1	.281
318-22	700	1.79	1.426	.771	.057	.5958
318-22	2000	1.51	1.576	.937	.054	.4334
318-45	2000	1.37X	1.20	.78	.0078	.021
321-7	2000	1.54	1.04	.76	.028	.34714
321-9	700	1.46	1.24	.98	.0073	.205
321-9	2000	1.36	1.4	1.2	.0057	.016
321-13	700	--	2.00	.96	.042	.49883
321-13	1504	1.50X[3]	1.09	.51	.046	.48293
321-13	1795	1.44X	1.24	.77	.044	.47032
321-17	2000	1.43	1.17	.59	2.15	.299
321-18	2000	1.67	1.16	.87	.175	.247

*Glassy Carbon No. 1 - Le Carbone, p. 6927.
[1]Real density as determined by He pycnometry
[2]Real density as determined by Hg
[3]X indicates Xylene

Sample #	Temp. °C	ρHe real[1] (g/cc)	ρHg real[2] (g/cc)	ρHg app. (g/cc)	MPD (μ)	IPV (cc/g)
321-19	2000	1.80	1.56	.98	.049	.379
321-20	2000	1.60	1.63	.70	.088	.345
321-21	2000	1.79	1.30	.85	.041	.377
321-25	2000	--	2.20	1.14	.011	.088
321-31	2000	1.41	1.49	1.34	.0195	.075
322-14A	1300	--	--	--	2.2	.826
322-14A	1412	1.74	--	--	1.7	.494
322-14B	1300	--	--	--	2.3	.501
322-14B	1412	--	--	--	1.5	.496
322-17A	1300	--	--	--	4.5	.604
322-17A	1412	--	--	--	4.4	.271
322-17B	1300	--	--	--	2.5	.382
322-17B	1412	--	--	--	2.0	.534
322-19A	1300	--	--	--	1.0	.461
322-19A	1412	1.9	--	--	.08	.472
322-19B	1300	--	--	--	.65	.466
322-19B	1412	--	--	--	.95	.468
322-20	1300	--	--	--	1.8	.432
322-20	1412	1.57X	--	--	1.5	.666
322-21A	1300	1.50X	--	--	18.0	.503
322-21A	1412	--	--	--	3.5	.420
322-21B	1412	1.52X	--	--	10.0	.400
322-21D	1300	--	--	--	8.0	.780
322-22A	1300	--	--	--	1.1	.308
322-22A	1412	1.48X	--	--	1.2	.443
322-22B	1300	--	--	--	1.4	.457
322-22B	1412	1.49X	--	--	1.2	.440
322-23A	1300	1.55X	--	--	1.5	.443
322-23A	1412	1.47X	--	--	1.2	.458
322-23B	1300	2.08X	--	--	.32	.453
322-23B	1412	1.61X	--	--	.35	.458
322-24A	1300	1.54X	--	--	1.3	.395
322-24A	1412	--	--	--	1.3	.563
322-24B	1300	--	--	--	1.9	.620
322-24B	1412	1.59X	--	--	1.4	.888
322-32	1350	1.60X	--	--	1.4	.571
322-35	1350	1.43X	--	--	6.0	.472
322-41	1440	1.59X	--	--	.07	.669
322-45	1500	1.72X	--	--	4.2	.421
322-46	1500	1.48X	--	--	1.4	.550
322-47A	1500	1.47X	--	--	1.3	.652
322-48	1605	1.53X	--	--	6.0	.634
322-49	1400	--	--	--	7.0	.841
322-49	1400	--	--	--	7.0	.607
322-49	1600	1.51X	--	--	7.0	.595
322-50	1600	1.52X	--	--	6.0	.545
322-50	1400	1.48X	--	--	6.0	.679
323-26A	1038	1.46X	1.37	.53	1.27	.497

TABLE 9 Physical Properties

Sample #	Temp. °C	$\rho_{app.}$ (g/cc)	ρ_{real} (g/cc) He	ρ_{real} (g/cc) Xyl	Resistivity Ω-cm (×10)	Hardness (DPH)	Int. Frict. (×10³)	Sonic Mod. psi (×10⁻⁶)	Compr. Str. psi (×10⁻³)	Ult. Str. psi (×10⁻³)
310-35	2000	(0.57)*	--	2.07	--	--	--	--	5.18	1.01
311-34	2000	(0.60)	--	--	--	--	--	--	7.2	7.04
311-35	2000	0.51			.294	--	1.43	0.35	6.85	1.23
312-13	2000	(1.07)	--	--	--	--	--	--	50.0	4.85
312-14	2000	(1.00)	1.44	--	--	--	--	--	36.0	--
312-16	2000	(0.77)	1.27	1.45	--	--	--	--	1.73	2.83
312-27	2000	(1.15)	--	--	--	--	--	--	--	7.78
312-29	2000	(1.07)	1.52	--	--	--	--	--	39.7	--
312-32	2000	(0.90)	1.47	--	--	--	--	--	29.2	5.13
312-33	2000	--	1.59	--	--	90	--	--	--	--
312-34	2000	(0.92)	1.38	--	--	--	--	--	27.3	1.11
312-44	2000	--	1.18	1.22	--	98	--	--	--	--
312-45	680	--	--	--	--	135	--	--	--	--
312-45A	2000	--	1.26	1.29	--	176	--	--	--	--
312-46	680	--	--	--	--	107	--	--	--	--
312-46	2000	--	--	--	--	105	--	--	--	--
312-49	2000	(1.10)	1.3	1.45	--	--	--	--	--	5.96
315-1	2000	(0.89)	1.49	--	--	--	--	--	--	--
315-2	2000	0.70	1.52	--	.349	--	--	1.27	1.47	0.36
315-3	2000	--	1.38	1.49	--	--	--	--	--	--
315-4	2000	--	1.55	--	--	--	--	--	--	--
315-14	2000	(0.96)	1.6	--	--	--	--	--	47.7	4.7
315-17	2000	(0.79)	--	1.45	--	--	--	--	29.3	2.51
315-20	2000	(0.84)	1.6	--	--	--	--	--	--	--
315-20A	2000	0.84	1.6	--	.180	--	0.93	1.48	--	--
315-20B	2000	0.77	1.60	--	.275	--	1.63	1.37	--	--

*Data in parenthesis obtained from unmachined cylinders. All other densities from machined cylinders.

Sample #	Temp. °C	$\rho_{app.}$ (g/cc)	ρ_{real} (g/cc) He	Xyl	Resistivity Ω-cm (×10)	Hardness (DPH)	Int. Frict. (×10³)	Sonic Mod. psi (×10⁻⁶)	Compr. Str. psi (×10⁻³)	Ult. Str. psi (×10⁻³)
315-20C	2000	0.88	1.60	--	.203	--	0.54	1.52	--	--
315-21B	2000	(0.96)	--	1.37	--	--	--	--	--	6.60
315-21C	2000	0.91	1.52	--	.147	--	0.26	1.54	46.8	7.13
315-21D	2000	(1.01)	--	1.47	--	--	--	--	27.0	7.62
315-22	2000	(0.90)	1.63	1.46	--	--	--	--	--	--
315-24	2000	(1.15)	1.78	--	--	--	--	--	--	--
315-25A	2000	(0.88)	--	1.43	--	--	--	--	24.3	4.61
315-25B	2000	(0.87)	--	1.58	--	--	--	--	--	4.78
315-25C	2000	0.88	1.41	--	.317	--	2.38	1.55	35.5	7.38
315-26B	2000	(0.88)	--	1.45	--	--	--	--	30.5	6.63
315-26C	2000	0.80	1.45	--	.057	--	--	1.20	25.6	4.24
315-26D	2000	0.83	1.45	--	.149	--	--	1.38	36.6	--
315-28	2000	(0.96)	1.46	--	--	--	--	--	37.3	4.39
315-30	2000	(0.91)	1.49	--	--	--	--	--	--	--
315-31	2000	(0.85)	1.48	--	--	--	--	--	--	--
315-31B	2000	0.80	1.46	--	.119	--	0.33	1.44	35.1	5.15
315-31C	2000	0.93	1.48	--	.237	--	0.47	1.65	--	--
315-31D	2000	0.91	1.46	--	.229	--	0.42	1.60	36.2	6.6
315-32	2000	(0.99)	1.43	--	--	--	--	--	45.0	6.35
315-33	2000	0.78	1.50	--	.195	--	1.50	1.26	--	--
315-34C	2000	0.60	1.58	--	.294	--	0.31	0.87	21.0	2.95
315-34D	2000	0.66	1.57	--	.137	--	2.01	1.22	16.4	2.73
315-35B	2000	(0.87)	1.89	1.75	--	--	--	--	--	--
315-37	2000	0.53	1.61	1.48	.262	--	0.31	0.61	14.2	2.51
315-38	2000	(0.72)	1.51	--	--	--	--	--	--	--
315-38A	2000	0.72	1.51	--	.237	--	--	0.93	2.40	2.97
315-39A	2000	0.96	1.64	1.43	.188	--	0.47	1.78	35.9	5.59
315-39B	2000	0.96	1.64	1.43	.029	--	1.28	1.76	28.5	4.41
315-40	2000	(0.87)	1.33	1.41	--	--	--	--	--	--
315-41	2000	0.68	1.67	1.41	.220	--	--	--	15.0	--
315-41A	2000	0.77	1.67	--	.038	--	1.18	1.35	18.6	2.0
315-41B	2000	0.79	1.67	--	.157	--	0.98	1.28	16.0	2.02
315-42	2000	0.87	1.83	1.47	.249	--	0.35	1.65	--	--

Sample #	Temp. °C	$\rho_{app.}$ (g/cc)	ρ_{real} (g/cc) He	Xyl	Resistivity Ω-cm (×10)	Hardness (DPH)	Int. Frict. ($\times 10^3$)	Sonic Mod. psi ($\times 10^{-6}$)	Compr. Str. psi ($\times 10^{-3}$)	Ult. Str. psi ($\times 10^{-3}$)
315-43	2000	(1.04)	--	1.48	--	--	--	--	50.0	--
315-44	2000	0.76	1.78	1.43	.214	--	0.32	1.43	--	--
315-45	2000	(0.88)	1.39	1.49	--	--	--	--	--	--
315-45B	2000	0.76	--	1.67	.039	--	0.28	5.8	--	--
315-46	2000	(1.094)	--	1.51	--	240	--	--	--	--
315-46	2000	(1.094)	--	1.51	--	105	--	--	--	--
315-46A	2000	(.899)	1.55	--	--	58	--	--	2.5	2.23
317-1	2000	(1.21)	1.67	1.21	--	--	--	--	56.5	7.5
317-2	2000	0.71	1.74	1.45	.088	--	--	0.91	23.7	2.97
317-5	2000	(0.78)	1.42	1.31	--	58	--	--	33.1	7.50
317-6	2000	(0.78)	1.88	1.45	--	--	--	--	--	--
317-7	2000	(0.79)	1.82	1.43	--	--	--	--	--	--
317-8	2000	1.00	1.64	1.44	--	--	--	1.82	40.5	2.29
317-9	2000	(0.93)	1.76	--	--	--	--	--	32.3	5.77
317-10	2000	0.79	1.42	--	.009	--	0.75	1.45	43.7	6.00
317-12	2000	(0.89)	1.60	--	--	--	--	--	--	5.82
317-13	2000	(0.88)	1.88	1.45	--	--	--	--	--	--
317-14	2000	(0.87)	1.49	--	--	--	--	--	27.4	4.69
317-15	2000	(0.91)	1.46	--	--	--	--	--	33.6	4.09
317-18	2000	0.72	1.50	1.26	.088	--	0.39	0.86	5.1	3.30
317-19	2000	(1.13)	1.68	--	--	--	--	--	28.2	8.75
317-20	2000	(1.05)	1.51	--	--	--	--	--	--	--
317-23	2000	(0.83)	--	1.46	--	--	--	--	7.6	1.90
317-24	2000	0.76	1.57	--	.187	--	0.76	1.45	49.1	4.37
317-25	2000	(0.88)	1.69	1.41	--	--	--	--	34.1	2.85
317-26	2000	0.78	1.48	--	.195	14	0.66	1.51	4.7	0.92
317-27	2000	--	--	--	--	--	--	--	37.3	--
317-28	2000	(0.93)	1.7	1.45	--	--	--	--	--	--
317-29	2000	0.74	1.65	1.49	.122	--	--	0.86	16.4	2.48
317-30	2000	(0.77)	1.68	1.51	--	--	--	--	--	--
317-31	2000	(0.70)	1.45	--	--	--	--	--	--	--
317-32	2000	0.89	1.72	1.43	.224	--	--	1.64	44.2	5.05
317-33	2000	(1.02)	1.46	--	--	73	--	--	40.2	5.60

Sample #	Temp. °C	$\rho_{app.}$ (g/cc)	ρ_{real} (g/cc) He	Xyl	Resis-tivity Ω-cm (×10)	Hard-ness (DPH)	Int. Frict. ($\times 10^3$)	Sonic Mod. psi ($\times 10^{-6}$)	Compr. Str. psi ($\times 10^{-3}$)	Ult. Str. psi ($\times 10^{-3}$)
317-34	2000	0.65	1.56	1.50	.321	--	--	2.07	24.0	4.61
317-35	2000	(0.98)	1.40	--	--	--	--	--	--	--
317-37	2000	0.90	1.34	1.43	.225	80	0.31	1.61	40.6	6.90
317-38	2000	0.90	1.34	1.43	.268	62	1.27	1.01	37.6	4.20
317-39	2000	0.77	1.27	--	.032	49	0.19	1.20	26.7	3.58
317-40	2000	0.85	1.47	--	.184	--	--	1.25	22.8	3.44
317-41	2000	(0.93)	--	1.59	--	--	--	--	10.0	2.35
317-41A	2000	(0.90)	--	1.37	--	--	--	--	7.4	1.91
317-41B	2000	(1.12)	1.48	--	--	--	--	--	27.0	3.90
317-42	2000	0.87	1.45	--	.135	53	--	1.54	39.8	5.30
317-43	2000	(0.90)	1.40	--	--	--	--	--	15.0	2.47
317-44	2000	0.84	1.51	--	.007	52	1.68	1.35	27.3	2.13
317-45	2000	(0.88)	1.40	--	--	--	--	--	32.3	5.2
317-46	2000	0.81	1.48	--	.112	71	--	1.27	34.6	4.95
317-47	2000	(0.97)	1.39	--	--	49	--	--	27.5	5.62
317-48	2000	1.16	1.46	--	--	--	--	1.23	--	--
317-49	2000	0.80	1.51	--	.34	--	1.31	0.89	11.1	3.0
318-1	2000	0.79	1.51	--	.169	--	--	0.71	--	2.56
318-2	2000	(0.95)	1.45	--	--	--	--	--	--	--
318-2C	680	0.89	--	--	907.0	--	--	0.80	34.5	4.77
318-3	2000	--	1.37	1.51	--	--	--	--	--	--
318-6A	2000	(1.17)	1.45	--	--	--	--	--	--	--
318-7	2000	0.78	--	1.34	.165	--	--	0.65	.82	1.67
318-8	2000	(0.96)	1.49	--	--	60	--	--	18.2	5.62
318-8A	2000	(0.97)	--	1.49	--	--	--	--	32.7	--
318-9	2000	(0.96)	1.50	--	--	56	--	--	27.4	5.19
318-10	2000	(0.99)	1.48	--	--	--	--	--	--	--
318-11	2000	0.91	1.58	--	--	51	--	1.48	--	5.09
318-12	2000	(0.98)	1.50	--	--	61	--	--	--	--
318-13	2000	(1.03)	--	1.23	--	71	--	--	--	--
318-14	2000	0.77	1.47	--	.285	31	0.41	0.41	4.74	0.83
318-15	2000	(0.95)	1.51	--	--	40	--	--	--	--
318-16	2000	0.94	1.48	--	.270	47	--	1.43	28.2	4.02

Sample #	Temp. °C	$\rho_{app.}$ (g/cc)	ρ_{real} (g/cc) He	ρ_{real} (g/cc) Xyl	Resis-tivity Ω-cm (×10)	Hard-ness (DPH)	Int. Frict. (×10³)	Sonic Mod. psi (×10⁻⁶)	Compr. Str. psi (×10⁻³)	Ult. Str. psi (×10⁻³)
318-17	2000	0.74	1.46	--	.189	53	0.18	1.18	33.2	4.35
318-18	2000	--	1.48	--	--	46	--	--	--	--
318-18B	2000	--	--	--	--	--	--	--	--	5.28
318-19	2000	(0.77)	1.41	--	--	--	--	--	--	--
318-20	2000	--	1.50	--	--	65	--	--	--	--
318-21	2000	--	1.37	1.49	--	56	--	--	--	--
318-22	2000	0.83	1.45	--	.237	44	--	1.29	29.5	4.37
318-22	700	(0.78)	1.48	--	--	39	--	--	--	--
318-23	2000	(0.91)	1.49	--	--	54	--	--	--	--
318-24	2000	0.97	1.29	1.52	--	61	--	1.49	--	--
318-24C	2000	0.92	1.29	1.53	--	--	--	--	25.0	4.47
318-26	2000	(0.98)	1.59	--	--	70	--	--	--	--
318-27	2000	(0.87)	1.38	--	--	--	--	--	--	--
318-28	2000	0.84	1.45	--	.177	--	--	1.33	--	--
318-29	2000	0.63	1.45	--	.194	26	--	--	0.23	0.73
318-30	2000	1.08	1.49	--	--	60	--	1.52	21.9	5.82
318-31	2000	0.55	1.31	1.36	.216	21	2.41	0.135	1.6	0.19
318-32	2000	(0.84)	1.57	--	--	53	--	--	19.7	--
318-33	2000	0.80	--	1.53	.101	57	0.73	1.37	32.2	4.75
318-34	2000	1.07	1.45	--	--	--	--	--	28.7	4.85
318-35	2000	0.88	1.43	--	.118	--	--	1.48	26.4*	4.57
318-36	2000	1.02	1.41	--	.107	67	--	1.35	18.6*	3.34
318-37	2000	0.92	1.48	--	.112	--	--	2.17	25.7*	3.90
318-38	2000	--	1.52	--	--	--	--	--	--	--
318-39	2000	1.23	1.57	--	.085	--	--	2.99	34.9*	7.95
318-41	2000	(1.05)	1.44	--	--	--	--	--	--	--
318-43	2000	(1.08)	--	1.42	--	106	--	--	--	--
318-44	2000	(1.09)	--	1.46	--	103	--	--	--	--
318-45	2000	1.27	--	1.37	.070	--	--	3.1	--	--
318-46	2000	1.02	--	1.46	.41	56	--	2.34	42.3*	7.35
318-48	2000	1.08	1.43	--	--	--	--	--	3.5	8.27

*Head speed .05 in/min., all others .02 in/min.

Sample #	Temp. °C	$\rho_{app.}$ (g/cc)	ρ_{real} (g/cc) He	ρ_{real} (g/cc) Xyl	Resistivity Ω-cm (×10)	Hardness (DPH)	Int. Frict. ($\times 10^3$)	Sonic Mod. psi ($\times 10^{-6}$)	Compr. Str. psi ($\times 10^{-3}$)	Ult. Str. psi ($\times 10^{-3}$)
318-50	2000	--	--	--	--	--	--	--	--	5.73
318-51	2000	(0.88)	1.43	--	--	--	--	0.83	17.3	1.44
318-52	2000	1.01	1.41	--	.130	--	--	1.66	17.7	2.54
318-53	2000	(0.87)	1.42	--	--	--	--	--	4.73	1.60
318-56	2000	(0.85)	1.34	1.43	--	--	--	--	--	--
318-58	2000	0.98	--	1.51	.237	--	--	0.10	--	6.02
318-59	2000	0.99	1.38	1.38	--	--	--	2.15	31.7	4.20
318-60	2000	0.95	1.71	1.42	.150	54	--	1.78	36.2*	7.63
318-61	2000	1.01	1.75	1.38	.403	--	--	1.47	22.6*	3.96
318-62	2000	0.90	1.39	--	--	69	--	--	41.4	6.98
321-1B	2000	--	--	--	--	--	--	--	4.36	.87
321-3	2000	0.98	1.57	--	.340	78	--	--	40.0*	7.18
321-5	2000	(0.99)	1.52	--	--	--	--	--	--	--
321-6	2000	1.09	1.60	--	.31	81	--	2.33	41.7*	8.27
321-7	2000	(0.91)	1.54	--	--	--	--	--	--	--
321-8	2000	0.90	1.46	--	.546	105	--	1.48	38.9*	7.00
321-9	2000	1.17	1.36	1.28	--	120	--	--	54.2	9.75
321-10	2000	1.26	1.34	--	.100	99	--	2.99	54.9*	10.85
321-11	2000	0.95	1.43	--	.114	95	--	1.54	40.5	5.16
321-11C	2000	--	--	--	--	132	--	--	37.0	6.08
321-12	2000	0.97	1.32	--	.121	--	--	1.22	14.9	2.52
321-13	2000	0.95	1.48	1.50	.115	131	--	1.67	36.2	6.04
321-15	2000	(0.96)	1.56	--	--	--	--	--	34.5	5.98
321-16A	2000	(0.85)	1.84	--	--	--	0.21	1.55	24.3	4.52
321-16B	2000	(0.93)	1.75	1.39	--	--	--	--	--	--
321-17B	2000	(0.94)	1.41	--	--	--	0.22	1.81	36.7	5.26
321-18A	2000	(0.95)	1.67	1.42	--	--	--	--	--	--
321-18B	2000	(0.64)	--	1.49	--	--	0.2	1.73	39.6	5.67
321-19A	2000	(0.87)	1.68	1.42	--	115	0.15	1.83	31.5	6.04
321-19B	2000	(0.83)	1.80	1.46	--	87	0.11	1.49	31.4	5.76
321-20A	2000	(0.99)	1.72	1.41	--	--	--	--	--	--

*Head speed .05 in/min., all others .02 in/min.

Sample #	Temp. °C	$\rho_{app.}$ (g/cc)	ρ_{real} (g/cc) He	ρ_{real} (g/cc) Xyl	Resistivity Ω-cm (×10)	Hardness (DPH)	Int. Frict. (×10³)	Sonic Mod. psi (×10⁻⁶)	Compr. Str. psi (×10⁻³)	Ult. Str. psi (×10⁻³)
321-20B	2000	(0.70)	1.50	--	--	--	--	--	34.8	6.21
321-21A	2000	0.94	1.74	1.45	.2	--	--	1.65	45.5	6.35
321-21B	2000	1.00	--	1.47	.2	--	--	1.93	46.4	6.16
321-22A	2000	0.94	1.79	1.44	.28	--	--	1.44	31.9	6.14
321-22B	2000	(0.98)	--	1.54	--	--	--	--	34.8	4.58
321-22C	2000	0.93	--	1.50	.17	--	--	1.43	36.1	4.35
321-22D4	2000	0.92	--	1.47	.19	--	--	1.42	33.7	5.15
321-23	2000	1.04	1.74	--	.12	--	--	2.05	58.6	7.28
321-23A	2000	0.96	--	1.53	.27	--	--	1.64	40.9	6.36
321-23B	2000	0.97	1.77	1.44	.18	--	--	1.69	42.7	5.98
321-24	2000	1.02	--	1.60	.19	--	--	1.95	47.8	6.39
321-24A	2000	0.95	--	1.46	.14	--	--	1.05	49.1	7.04
321-24B	2000	1.07	--	1.48	.15	--	--	2.22	45.1	6.76
321-25A	2000	0.70	--	1.45	.13	--	--	0.68	27.9	5.14
321-26	2000	(0.50)	1.43	1.56	--	--	--	--	26.4	0.77
321-26A	2000	(0.45)	1.54	--	--	--	--	--	--	--
321-27	2000	0.86	1.52	--	.11	--	--	0.62	9.7	1.34
321-29	2000	0.96	1.64	1.42	.18	--	--	1.59	40.0	5.94
321-31	2300	(0.81)	1.41	--	--	--	--	--	--	--
321-31A	2300	(0.97)	1.40	--	--	--	--	--	--	--
321-31B	2300	(0.91)	1.56	--	--	--	--	--	--	--
321-31C	2300	(0.88)	1.41	--	--	--	--	--	--	--
321-31D	2300	--	--	1.53	--	--	--	--	33.3	4.08
321-31F	2300	0.75	--	1.68	.23	--	--	0.70	13.6	2.23
321-31G	2300	1.03	1.66	--	.18	--	--	--	22.2	3.53
321-31I	2300	(1.02)	1.48	--	--	--	--	--	--	--
321-31J	2000	0.91	--	1.48	.16	--	--	1.15	22.6	3.99
321-31P	2000	0.89	--	1.25	.24	--	--	1.16	25.0	3.60
321-31Q	2000	0.98	--	1.53	.17	--	--	1.64	40.5	6.23
321-31R	2000	0.87	--	1.48	.18	--	--	0.85	12.2	1.85
321-31S	2000	0.96	--	1.39	.17	--	--	1.53	36.9	5.58
321-32A	2000	0.94	1.36	1.50	.18	--	--	0.91	35.5	3.78
321-32B	2000	0.93	1.30	1.52	.20	--	--	0.92	36.9	5.76

Sample #	Temp. °C	$\rho_{app.}$ (g/cc)	ρ_{real} (g/cc) He	ρ_{real} (g/cc) Xyl	Resistivity Ω-cm (×10)	Hardness (DPH)	Int. Frict. (×10³)	Sonic Mod. psi (×10⁻⁶)	Compr. Str. psi (×10⁻³)	Ult. Str. psi (×10⁻³)
321-32C	2000	0.92	1.25	1.50	.21	--	--	0.93	41.4	6.11
321-32D	2000	0.92	--	1.47	.25	--	--	1.49	--	--
321-32D₁	2000	0.84	--	1.47	.29	--	--	0.2	--	--
321-32E	2000	0.94	1.33	--	.24	--	--	1.56	41.9	5.89
321-32F	2000	(0.96)	--	1.54	--	--	--	.91	33.3	4.28
321-32G	2000	0.95	--	--	.22	--	--	1.56	31.8	4.53
321-33A	2000	0.94	1.41	--	.16	--	--	--	39.8	5.96
321-33B	2000	0.89	--	1.47	.33	--	--	1.49	53.6	6.69
321-34	2300	(0.95)	1.6	--	--	--	--	--	--	--
321-34A	2300	0.96	1.59	--	.27	--	--	1.49	31.3	7.55
321-34B	2300	0.94	--	1.59	.18	--	--	2.94	33.3	2.92
321-34D	2300	0.95	--	1.49	--	--	--	1.46	--	--
321-34E	2300	0.95	1.21	--	.38	--	--	0.92	40.9	5.43
321-36A	2300	(1.11)	1.80	1.44	--	--	--	--	--	2.46
321-36B	2300	1.07	1.66	1.35	.29	--	--	1.15	50.4	7.23
321-36C	2300	(1.11)	1.43	--	--	--	--	--	--	--
321-37	2300	(1.07)	1.41	--	--	--	--	--	--	--
321-37B	2300	.66	1.50	--	.24	--	--	0.42	5.53	1.09
321-37D₁	2300	--	--	--	--	--	--	--	2.51	0.45
321-37E	2300	0.79	--	1.76	.44	--	--	0.94	1.39	0.36
321-37F	2300	0.65	--	1.56	--	--	--	0.08	1.05	0.22
321-37Q	2300	0.71	--	1.62	.31	--	--	0.2	1.67	0.40
321-39	2300	0.84	1.60	--	.23	--	--	0.72	6.80	1.31
321-40	2300	(0.60)	1.42	--	.30	--	--	--	0.50	.06
321-41B	2300	(0.77)	1.51	--	--	--	--	--	--	--
321-42A	2000	0.77	--	1.44	.29	--	--	0.35	2.05	0.57
321-42B	2000	0.65	1.48	--	.28	--	--	0.20	1.14	0.42
321-43A	2200	0.73	1.55	--	.36	--	--	0.60	1.31	0.37
321-43B	2200	0.61	1.44	--	.46	--	--	0.10	0.73	0.22
321-44A	2200	(0.96)	1.81	1.46	--	--	--	--	--	--
321-44B	2200	(0.98)	1.56	--	--	--	--	--	--	--
321-45A	2200	(1.17)	1.78	1.42	--	--	--	--	--	--
321-45B	2200	(1.06)	1.84	1.50	.09	--	--	0.42	41.50	5.93

Sample #	Temp.°C	$\rho_{app.}$ (g/cc)	ρ_{real} (g/cc) He	ρ_{real} (g/cc) Xyl	Resis-tivity Ω-cm (×10)	Hard-ness (DPH)	Int. Frict. (×10³)	Sonic Mod. psi (×10⁻⁶)	Compr. Str. psi (×10⁻³)	Ult. Str. psi (×10⁻³)
321-46A	2200	(0.83)	1.40	--	--	--	--	--	--	--
321-46B	2200	0.82	1.43	--	.26	--	--	0.16	2.04	0.49
321-46C	2200	(0.87)	1.60	--	--	--	--	--	--	--
321-47A	1600	(1.13)	2.07	1.48	--	--	--	--	--	--
321-47B	1600	(1.18)	1.67	--	--	--	--	--	--	--
321-47C	1600	(0.91)	1.84	1.45	--	--	--	--	--	--
321-48A	1600	(0.79)	1.40	--	--	--	--	--	--	--
321-48B	1600	0.83	1.43	--	.24	--	--	0.34	2.65	0.60
321-48C	2000	(0.78)	1.58	--	--	--	--	--	--	--
321-49A	1600	(0.91)	1.51	--	--	--	--	--	--	--
321-49B	1600	(0.80)	1.44	--	--	--	--	--	--	--
321-49C	1600	(0.91)	1.51	--	--	--	--	--	--	--
321-50	1600	(1.00)	1.69	--	--	--	--	--	--	--
321-50B	1600	1.02	1.43	--	.15	--	--	1.5	28.2	4.52
321-50C	1600	(1.03)	1.45	--	--	--	--	--	--	--
321-51	2350	(0.99)	1.50	--	--	--	--	0.73	9.1	1.36
321-51A	2350	0.96	1.53	--	.21	--	--	--	--	--
321-52	2000	--	1.3	1.52	--	--	--	--	--	--
321-53	2000	(1.12)	2.07	1.47	--	--	--	--	--	--
322-1A	1600	0.82	--	1.59	.24	--	--	0.27	4.00	0.78
322-1B	1600	0.83	1.98	--	.39	--	--	0.26	--	--
322-2A	1600	(0.87)	2.02	1.59	--	--	--	--	--	--
322-3A	1600	0.71	--	1.59	.18	--	--	0.73	6.80	0.69
322-3B	1600	(0.78)	2.0	1.52	--	--	--	--	--	--
322-5	2000	(0.86)	1.55	--	--	--	--	--	--	--
322-6	2000	(0.86)	1.41	--	--	--	--	--	--	--
322-10C	2100	(0.84)	1.8	--	--	--	--	--	--	--
322-11A	1670	0.74	--	1.49	.207	--	--	0.25	1.77	.59
322-11B	1670	0.72	1.9	--	.26	--	--	0.24	0.791	0.17
322-12A	1600	0.55	--	1.43	.28	--	--	0.24	2.23	0.24
322-12B	1600	0.73	--	1.50	.23	--	--	0.35	2.04	0.24
322-13A	1670	0.78	--	1.45	.17	--	--	0.59	4.06	--
322-14A	1670	(0.76)	1.74	--	--	--	--	--	--	--

Sample #	Temp. °C	$\rho_{app.}$ (g/cc)	ρ_{real} (g/cc) He	ρ_{real} (g/cc) Xyl	Resis-tivity Ω-cm (×10)	Hard-ness (DPH)	Int. Frict. ($\times10^3$)	Sonic Mod. psi ($\times10^{-6}$)	Compr. Str. psi ($\times10^{-3}$)	Ult. Str. psi ($\times10^{-3}$)
322-15B	1670	0.79	--	1.48	.19	--	--	0.57	6.82	--
322-16A	1670	(0.81)	1.89	--	--	--	--	--	--	--
322-16B	1670	0.78	--	1.54	.22	--	--	0.35	3.97	0.82
322-17B	1670	0.71	--	1.48	.37	--	--	0.2	--	0.37
322-18A	1670	1.07	--	1.49	.09	--	--	2.17	37.3	6.29
322-19A	1670	(0.85)	1.98	--	--	--	--	--	--	--
322-19B	1670	0.79	--	1.55	.28	--	--	0.33	4.16	0.41
322-20	1400	0.78	--	1.57	.17	--	--	0.77	8.97	1.43
322-21	1400	0.74	--	1.45	.22	--	--	0.53	3.34	0.74
322-22A	1400	(0.88)	--	1.48	--	--	--	--	4.1	1.19
322-22B	1400	(0.89)	--	1.49	--	--	--	--	5.2	1.19
322-23A	1400	(0.84)	--	1.47	--	--	--	--	--	--
322-23B	1300	(0.83)	--	1.61	--	--	--	--	--	4.07
322-24A	1300	(0.87)	--	1.51	--	--	--	--	--	1.28
322-24B	1400	(0.82)	--	1.59	--	--	--	--	--	1.28
322-25A	1410	0.82	--	1.48	.11	--	--	1.56	23.17	3.24
322-25A	1670	0.88	--	1.64	.13	--	--	1.48	19.68	2.17
322-26	1400	0.98	--	--	.11	--	--	2.04	27.15	3.6
322-27A	1400	0.83	--	1.42	.08	--	--	1.58	24.94	2.63
322-28A	1400	(0.93)	--	1.44	.10	--	--	--	18.4	3.16
322-29A	1400	0.66	--	1.46	.19	--	--	0.68	10.62	1.63
322-30	1410	0.85	1.64	1.42	.18	--	--	0.79	2.68	0.773
322-31B	1410	0.69	--	1.58	.34	--	--	0.24	1.85	0.363
322-32	1350	0.74	--	1.60	.24	--	--	0.36	3.06	0.465
322-33	1350	0.71	--	1.62	.22	--	--	0.60	2.775	1.32
322-34	1350	0.75	--	1.34	.13	--	--	1.07	13.43	3.85
322-35	1350	0.77	--	1.43	.22	--	--	0.68	11.8	1.33
322-36	1543	0.88	--	1.45	.10	--	--	1.29	23.0	3.74
322-37	1543	0.78	--	1.44	.20	--	--	0.47	3.697	1.178
322-38	1543	0.73	--	1.68	.17	--	--	0.93	11.16	2.47
322-39	1440	0.59	--	1.55	.18	--	--	0.72	10.1	2.94
322-40	1440	0.79	--	1.59	.11	--	--	1.14	13.95	3.45
322-41	1440	0.73	--	1.59	.17	--	--	0.84	9.83	2.597

Sample #	Temp.°C	$\rho_{app.}$ (g/cc)	ρ_{real} (g/cc) He	ρ_{real} (g/cc) Xyl	Resistivity Ω-cm (×10)	Hardness (DPH)	Int. Frict. ($\times 10^3$)	Sonic Mod. psi ($\times 10^{-6}$)	Compr. Str. psi ($\times 10^{-3}$)	Ult. Str. psi ($\times 10^{-3}$)
322-42A_3	1440	0.72	--	--	.14	--	--	0.88	10.77	2.97
322-42A_4	1440	0.64	--	--	.23	--	--	0.68	13.9	1.00
322-42B_1	1440	0.66	--	1.44	.20	--	--	0.69	9.89	1.96
322-42B_2	1440	0.75	--	1.46	.18	--	--	0.87	13.19	2.22
322-42B_3	1440	0.73	--	1.46	.27	--	--	0.89	19.4	3.11
322-42B_4	1440	0.66	--	1.51	.17	--	--	0.70	12.2	1.07
322-42B_5	1440	0.68	--	--	.19	--	--	0.76	14.45	2.50
322-42B_6	1440	0.75	--	1.49	.19	--	--	0.97	16.85	1.26
322-45	1440	0.82	--	1.72	.20	--	--	0.68	6.76	2.04
322-48	1605	0.68	--	1.48	.29	--	--	0.43	2.16	0.992
322-49A	1605	0.79	--	1.46	.15	--	--	0.79	13.2	2.24
322-50	1600	0.73	--	1.52	.15	--	--	0.56	7.11	1.38
322-51	1460	(0.78)	--	1.56	--	--	--	--	--	--
322-56	1500	(1.00)	--	1.53	--	--	--	--	--	--
322-56A	1500	(0.96)	--	1.33	--	--	--	--	--	--
322-57	1500	(1.06)	--	1.63	--	--	--	--	--	--
322-57A	1500	(1.03)	--	1.62	--	--	--	--	--	--
322-61	1500	0.74	--	1.46	.189	--	--	0.4	3.92	1.01
322-62	1500	0.96	--	1.49	.095	--	--	1.21	16.5	3.12
322-63	1500	1.00	--	1.56	.074	--	--	1.69	35.8	4.11
322-63A	1500	1.19	--	1.49	.057	--	--	2.47	24.3	5.13
322-64	1370	0.98	--	1.60	.076	--	--	1.92	45.6	5.41
322-64A	1370	(1.10)	--	1.51	--	--	--	--	--	--
322-64B	1370	0.93	--	1.61	.085	--	--	1.89	38.9	5.93
322-65	1370	(1.28)	--	1.43	--	--	--	--	--	--
322-66	1370	(1.09)	--	1.37	--	--	--	--	--	--
322-67	1350	0.85	--	1.64	.099	--	--	1.32	30.9	4.86
322-67A	1370	(0.84)	--	1.52	--	--	--	--	--	--
322-67B	1370	0.82	--	1.41	.101	--	--	1.33	27.9	4.48
322-68	1370	0.74	--	1.52	.180	--	--	0.53	7.6	1.47
322-68A	1370	(0.79)	--	1.25	.150	--	--	--	--	--
322-68B	1370	(0.77)	--	1.48	--	--	--	--	--	--
322-69	1370	0.69	--	1.50	.189	--	--	0.42	5.2	1.19

Sample #	Temp.°C	$\rho_{app.}$ (g/cc)	ρ_{real} (g/cc) He	Xyl	Resistivity Ω-cm (×10)	Hardness (DPH)	Int. Frict. (×10³)	Sonic Mod. psi (×10⁻⁶)	Compr. Str. psi (×10⁻³)	Ult. Str. psi (×10⁻³)
322-69A	1370	0.72	--	1.47	.198	--	--	0.42	5.1	1.38
322-70	1370	0.69	--	1.44	.224	--	--	0.38	6.09	1.14
323-1	1370	(1.01)	--	1.46	--	--	--	--	--	--
323-2	1370	0.78	--	1.45	.112	--	--	1.15	26.7	4.33
323-2A	1370	0.80	--	1.44	.111	--	--	1.30	26.5	4.1
323-3	1370	(0.98)	--	1.51	--	--	--	--	--	--
323-3A	1370	1.13	--	1.53	.061	--	--	2.48	48.5	6.51
323-4	1370	0.78	--	1.47	.176	--	--	0.55	8.6	1.88
323-4A	1370	0.78	--	1.47	.179	--	--	0.55	8.39	1.73
323-5	1000	0.74	--	1.50	.44	--	--	0.079	4.37	.82
323-5A	1000	0.72	--	1.46	.432	--	--	0.078	4.04	.94
323-6	1000	(0.92)	--	1.47	--	--	--	--	--	--
323-6A	1000	(0.91)	--	1.43	--	--	--	--	--	--
323-7	1000	(0.77)	--	1.51	--	--	--	--	--	--
323-7A	1000	0.77	--	1.50	.339	--	--	0.15	8.18	1.29
323-8	1000	(0.93)	--	1.51	--	--	--	--	--	--
323-8A	1000	1.0	--	1.52	.191	--	--	0.28	20.96	4.43
323-9	1000	1.03	--	1.51	.166	--	--	0.31	12.59	3.10
323-9A	1000	1.07	--	1.52	.179	--	--	0.14	12.75	1.83
323-11A	1000	(0.77)	--	1.50	--	--	--	--	--	--
323-11B	1000	0.77	--	1.49	.435	--	--	0.079	5.35	1.01
323-11C	1000	(0.73)	--	1.50	--	--	--	--	--	--
323-11D	1000	(0.71)	--	1.51	--	--	--	--	--	--
323-11E	1000	0.79	--	1.47	.406	--	--	--	5.38	1.83
323-11F	1000	0.74	--	1.52	.433	--	--	0.059	3.97	.84
323-11G	1000	(0.78)	--	1.52	--	--	--	--	--	--
323-12	1000	1.04	--	1.53	.19	--	--	0.24	10.63	2.1
323-12A	1000	1.06	--	1.51	.207	--	--	0.22	6.58	2.74
323-13	1000	1.12	--	1.53	.161	--	--	0.386	15.42	2.7
323-13A	1000	1.13	--	1.53	.157	--	--	0.387	16.00	2.51
323-14	1000	1.17	--	1.56	.123	--	--	--	17.00	3.12
323-15	1000	(0.97)	--	1.55	--	--	--	--	--	--
323-15A	1000	(0.95)	--	1.55	--	--	--	--	--	--

Sample #	Temp. °C	$\rho_{app.}$ (g/cc)	ρ_{real} (g/cc) He	ρ_{real} (g/cc) Xyl	Resistivity Ω-cm (×10)	Hardness (DPH)	Int. Frict. ($\times 10^3$)	Sonic Mod. psi ($\times 10^{-6}$)	Compr. Str. psi ($\times 10^{-3}$)	Ult. Str. psi ($\times 10^{-3}$)
323-19	1000	0.6	--	1.50	.549	--	--	0.075	3.21	.67
323-20	1000	0.85	--	1.50	.172	--	--	0.28	31.6	4.08
323-20A	1000	0.82	--	1.50	.186	--	--	0.26	20.0	4.54
323-21	1000	0.92	--	1.42	.199	--	--	0.23	11.72	3.03
323-22	1000	0.86	--	1.49	.179	--	--	0.29	27.45	5.01
323-23	1000	0.9	--	1.37	.192	--	--	0.25	9.35	2.02
323-24	1000	(1.08)	--	1.59	--	--	--	--	--	--
323-25	1038	0.66	--	1.49	.583	--	--	0.034	3.4	.69
323-25A	1038	0.67	--	1.47	.444	--	--	0.036	3.1	.54
323-26	1038	0.88	--	1.47	.223	--	--	0.207	13.8	2.32
323-26A	1038	0.88	--	1.46	.228	--	--	0.198	12.3	2.43
323-26B	1038	(0.94)	--	1.57	--	--	--	--	--	--
323-27	1038	0.94	--	1.45	.492	--	--	--	12.6	2.88
323-27A	1038	(0.89)	--	1.45	--	--	--	--	--	--
323-28	1038	0.93	--	1.43	.223	--	--	0.207	--	--
323-28A	1038	0.92	--	1.44	.267	--	--	0.18	8.71	1.59
323-29	1038	0.64	--	1.47	.705	--	--	--	3.64	.31
323-29A	1038	(1.19)	--	1.47	--	--	--	--	--	--
323-30A	1000	--	--	1.53	--	--	--	--	--	--
323-30B	1000	(1.18)	--	1.53	--	--	--	--	--	--
323-30C	1000	--	--	1.54	--	--	--	--	--	--
323-31	1038	0.82	--	1.36	.204	--	--	--	9.21	2.05
323-32	1038	0.92	--	1.46	.233	--	--	0.199	10.4	2.5
323-32A	1038	0.92	--	1.45	.226	--	--	0.21	--	2.77
323-32B	1038	--	--	1.42	--	--	--	--	--	--
323-32C	1038	--	--	1.45	--	--	--	--	--	--
323-32D	1038	--	--	1.44	--	--	--	--	--	--
323-33	1027	(0.79)	--	1.45	--	--	--	--	--	--
323-34	1038	1.06	--	1.45	.156	--	--	--	11.68	2.59
323-35	1027	(0.82)	--	1.48	--	--	--	--	--	--
323-35A	1082	0.9	--	1.44	.23	--	--	0.23	10.3	2.24
323-36	1027	0.71	--	1.5	--	--	--	--	--	--

Sample #	Temp.°C	$\rho_{app.}$ (g/cc)	ρ_{real} (g/cc) He	ρ_{real} (g/cc) Xyl	Resis-tivity Ω-cm (×10)	Hard-ness (DPH)	Int. Frict. (×10³)	Sonic Mod. psi (×10⁻⁶)	Compr. Str. psi (×10⁻³)	Ult. Str. psi (×10⁻³)
323-36A	1082	0.68	--	1.473	.395	--	--	0.081	5.52	2.53
323-38	1027	0.86	--	1.5	.24	--	--	0.188	11.2	2.5
323-38B	1082	0.9	--	1.53	.211	--	--	--	10.8	2.6
323-39	1082	0.99	--	1.44	.169	--	--	0.311	13.9	2.44
323-40	1027	0.98	--	1.47	.2	--	--	0.208	11.9	2.34
323-41	1027	0.84	--	1.49	.26	--	--	--	3.96	1.62
323-42	1082	0.9	--	--	.212	--	--	--	4.2	2.14
323-43	1027	0.88	--	1.48	.23	--	--	--	9.5	1.1
323-45	1027	0.82	--	1.50	.28	--	--	0.15	7.3	2.12
323-46	1027	0.87	--	1.51	.24	--	--	0.187	10.6	2.67
323-47	1027	0.91	--	1.48	.21	--	--	--	9.35	3.35
323-48	1027	0.87	--	1.50	.23	--	--	0.20	11.2	2.7
323-49	1027	0.90	--	--	.228	--	--	0.25	11.66	.94
323-50	1027	0.92	--	1.51	.15	--	--	0.29	35.6	4.58
323-51	1027	(1.12)	--	1.55	--	--	--	--	--	--
323-52	1027	(1.44)	--	1.45	--	--	--	--	--	--
323-54	1082	0.9	--	1.45	.184	--	--	--	10.02	1.83
323-55	1027	0.87	--	1.48	.22	--	--	0.20	12.1	1.28
323-56	1082	0.98	--	1.45	.153	--	--	--	15.3	2.76
323-57	1027	0.8	--	1.54	.25	--	--	0.175	9.11	1.48
323-58	1027	0.73	--	1.54	.33	--	--	0.114	6.8	1.85
323-62	1027	(1.13)	--	1.51	--	--	--	--	--	--
323-65	1027	0.92	--	1.48	.21	--	--	0.199	10.8	2.64
323-66	1027	0.90	--	1.49	.23	--	--	0.21	7.95	2.49
323-67	1000	0.97	--	1.45	.13	--	--	0.43	41.7	7.35
323-68	1000	0.82	--	1.52	.3	--	--	--	7.43	1.88
323-69	1000	0.86	--	1.49	.22	--	--	0.173	7.71	2.18
324-1	1000	0.78	--	1.49	.29	--	--	0.128	5.9	1.68
324-2	1000	0.79	--	1.45	.28	--	--	0.162	6.38	1.33
324-3	1000	0.80	--	1.52	.24	--	--	0.179	8.72	2.29
324-4	1000	0.99	--	1.52	.14	--	--	0.39	25.2	4.87
324-5	1000	0.75	--	1.52	.29	--	--	0.12	6.73	1.99
324-6	1000	0.78	--	1.53	.295	--	--	0.13	7.04	2.54

Sample #	Temp. °C	$\rho_{app.}$ (g/cc)	ρ_{real} (g/cc) He	ρ_{real} (g/cc) Xyl	Resistivity Ω-cm (×10)	Hardness (DPH)	Int. Frict. (×10^3)	Sonic Mod. psi (×10^{-6})	Compr. Str. psi (×10^{-3})	Ult. Str. psi (×10^{-3})
324-7	1000	0.78	--	1.48	.305	--	--	0.13	7.43	2.28
324-8	1000	0.78	--	1.52	.285	--	--	0.137	7.6	2.19
324-9	1000	0.80	--	1.53	.28	--	--	--	7.21	2.16
324-10	1000	(0.84)	--	1.50	--	--	--	--	--	--
324-11	1000	0.94	--	1.53	.14	--	--	0.305	27.4	4.15
324-12	1000	0.86	--	--	.19	--	--	0.25	18.0	3.02
324-13	1000	0.97	--	1.50	.14	--	--	0.337	32.9	5.37
324-14	850	1.07	--	1.41	.110	--	--	--	--	--
324-14	1066	1.09	--	1.42	.114	--	--	0.50	46.9	7.59
324-15	1066	0.96	--	1.48	.15	--	--	0.242	16.13	3.49
324-16	1066	1.0	--	1.47	.12	--	--	0.37	30.22	4.6
324-18	1066	0.99	--	1.56	.127	--	--	0.43	42.20	6.25
324-19	1066	0.83	--	1.54	.215	--	--	0.189	14.88	2.41
324-20	1066	0.84	--	1.49	.249	--	--	0.162	14.47	1.99
324-21	1066	1.04	--	1.49	.117	--	--	0.486	46.03	5.0
324-21A	1066	1.03	--	1.48	.127	--	--	0.46	37.00	4.9
324-22	1066	0.9	--	1.55	.185	--	--	--	23.37	3.74
324-23	1066	0.97	--	1.52	.2	--	--	0.295	14.39	2.33
324-24	1066	0.99	--	1.55	.183	--	--	0.256	15.73	2.4
324-25A	1066	0.84	--	1.42	.17	--	--	0.275	28.32	4.0
324-25B	1066	0.75	--	1.49	.537	--	--	0.039	2.99	.42
324-25C	1066	0.74	--	1.5	.382	--	--	0.089	3.82	.46
324-25D	1060	0.91	--	--	.165	--	--	--	22.99	4.84
324-26	1066	1.0	--	1.54	.119	--	--	0.46	44.83	5.7
324-27A	1060	0.71	--	1.53	.291	--	--	0.089	5.05	.95
324-27B	1060	0.5	--	1.56	1.102	--	--	0.007	.459	.12
324-27C	1060	0.5	--	1.54	1.472	--	--	--	.459	.10
324-27D	1060	0.52	--	1.53	1.116	--	--	--	.391	--
324-28	1060	--	--	1.54	--	--	--	--	--	--
324-29	1060	0.8	--	1.44	.269	--	--	0.105	3.11	.76
324-30	1060	--	--	1.60	--	--	--	--	--	--
324-31	1060	(0.72)	--	1.40	--	--	--	--	--	--
324-32	1060	0.93	--	1.54	.25	--	--	0.15	5.20	1.93

Sample #	Temp. °C	$\rho_{app.}$ (g/cc)	ρ_{real} (g/cc) He	Xyl	Resis-tivity Ω-cm (×10)	Hard-ness (DPH)	Int. Frict. $(\times 10^{3})$	Sonic Mod. psi $(\times 10^{-6}$	Compr. Str. psi $(\times 10^{-3})$	Ult. Str. psi $(\times 10^{-3})$
324-33	1060	0.82	--	1.50	.165	--	--	0.234	23.3	3.5
324-34	1060	1.02	--	1.57	.134	--	--	0.31	22.2	4.04
324-35	1060	0.97	--	1.56	.204	--	--	0.20	9.59	2.03
324-36	1060	(0.872)	--	1.54	--	--	--	--	--	--
324-37	1060	0.87	--	1.46	.206	--	--	0.19	7.20	1.83
324-38	1066	0.88	--	1.49	.232	--	--	--	9.11	1.94
324-39	1066	0.88	--	1.51	.278	--	--	0.17	7.91	1.99
324-40	1066	--	--	1.55	--	--	--	--	--	--
324-40D	1066	0.92	--	--	.185	--	--	0.20	9.08	2.12
324-40E	1066	0.89	--	1.43	.198	--	--	0.21	5.84	1.57
324-40A	1066	0.89	--	1.53	.277	--	--	0.105	4.28	1.02
324-41	1066	0.89	--	1.50	.219	--	--	0.19	10.1	2.34
324-42	1066	0.88	--	1.48	.203	--	--	0.18	6.07	2.06
324-43	1066	0.96	--	1.54	.173	--	--	0.265	11.6	3.37
324-44	1066	0.91	--	1.51	.204	--	--	0.17	11.9	2.08
324-45	1066	0.92	--	1.52	.183	--	--	0.27	12.0	3.47
324-46	1066	0.87	--	1.59	.184	--	--	0.20	6.98	2.41
324-47	1066	0.94	--	1.50	.208	--	--	0.17	6.12	1.53
324-48	1066	0.92	--	1.59	.195	--	--	0.20	9.7	2.47
324-49	1104	(0.78)	--	1.55	--	--	--	--	--	--
324-51	1104	1.11	--	1.54	.111	--	--	0.55	37.65	6.40
324-52	1104	1.0	--	1.50	.187	--	--	0.22	9.64	2.10
324-54	1066	(0.97)	--	1.59	--	--	--	--	--	--
324-56	1066	0.98	--	1.43	.202	--	--	0.20	8.77	2.63
324-57	1066	1.04	--	1.46	.135	--	--	0.45	21.5	--
324-58	1066	0.95	--	1.53	.183	--	--	0.29	8.36	2.17
324-59	1066	(0.78)	--	1.52	--	--	--	--	--	--
324-61	1066	1.04	--	1.45	.129	--	--	0.41	12.44	3.49
324-62	1066	0.98	--	1.47	.19	--	--	0.24	9.0	2.54
324-63	1066	0.95	--	1.51	.214	--	--	0.26	9.88	1.95
324-64	1066	(0.69)	--	1.56	--	--	--	--	--	--
324-65	1066	0.81	--	1.59	.267	--	--	0.13	6.81	--
324-66	1066	0.70	--	1.56	.347	--	--	0.066	3.36	.78

Sample #	Temp. °C	$\rho_{app.}$ (g/cc)	ρ_{real} (g/cc) He	ρ_{real} (g/cc) Xyl	Resistivity Ω-cm (×10)	Hardness (DPH)	Int. Frict. (×10^{3})	Sonic Mod. psi (×10^{-6})	Compr. Str. psi (×10^{-3})	Ult. Str. psi (×10^{-3})
324-67	1066	0.90	--	1.59	.251	--	--	0.14	8.62	1.76
324-68	1066	(0.81)	--	1.59	--	--	--	--	--	--
324-69	1066	0.78	--	1.52	.284	--	--	0.12	6.39	1.31
324-70	1066	0.79	--	1.55	.274	--	--	0.12	6.40	1.46
324-71	1066	0.91	--	1.54	.229	--	--	0.17	7.98	--
324-72	1066	0.72	--	1.55	.351	--	--	0.06	2.64	.54
325-1	1066	0.88	--	1.52	.163	--	--	0.30	31.09	3.55
325-2	1066	(0.95)	--	1.48	--	--	--	--	--	--
325-2A	1066	(0.91)	--	1.51	--	--	--	--	--	--
325-2C	1066	(0.87)	--	1.53	--	--	--	--	--	--
325-2D	1066	(0.83)	--	1.5	--	--	--	--	--	--
325-2E	1066	(0.82)	--	1.5	--	--	--	--	--	--
325-3	1066	(0.87)	--	1.49	--	--	--	--	--	--
325-5	1066	0.886	--	1.54	.260	--	--	--	8.14	1.58
325-6	1066	1.080	--	1.4	.234	--	--	--	38.97	6.89
325-7	1066	0.939	--	1.53	.138	--	--	--	11.33	2.83
325-8	1066	(0.72)	--	1.51	--	--	--	--	--	--
325-9	1066	(0.85)	--	1.57	--	--	--	--	--	--
325-10C	1066	0.852	--	1.52	.388	--	--	--	7.73	1.78
325-11	1066	0.761	--	1.54	.411	--	--	--	4.98	1.39
325-12	1066	0.784	--	1.66	.304	--	--	--	9.19	1.02
325-13	1066	0.820	--	1.47	.180	--	--	--	6.53	1.26
325-14	1066	0.912	--	1.49	.174	--	--	--	9.88	1.99
325-15	1066	(1.14)	--	1.56	--	--	--	--	--	--
325-16	1066	(0.77)	--	1.52	--	--	--	--	--	--
325-17	1066	(0.94)	--	1.44	--	--	--	--	--	--
325-18A	1066	0.747	--	1.55	.153	--	--	--	7.71	1.51
325-18B	1066	0.729	--	1.53	.315	--	--	--	6.58	1.47
325-18C	1066	0.769	--	1.57	.313	--	--	--	7.77	1.57
325-19A	1066	0.705	--	1.59	.321	--	--	--	8.17	1.65
325-19B	1066	0.730	--	1.56	.311	--	--	--	8.30	1.73
325-19C	1066	0.715	--	1.55	.283	--	--	--	8.44	1.61
325-20	1066	0.725	--	1.65	.369	--	--	--	7.32	1.49

Sample #	Temp.°C	$\rho_{app.}$ (g/cc)	ρ_{real} (g/cc) He	ρ_{real} (g/cc) Xyl	Resis-tivity Ω-cm (×10)	Hard-ness (DPH)	Int. Frict. (×10³)	Sonic Mod. psi (×10⁻⁶)	Compr. Str. psi (×10⁻³)	Ult. Str. psi (×10⁻³)
325-21	1066	0.807	--	1.54	.274	--	--	--	10.46	2.09
325-22	1066	0.868	--	1.60	.224	--	--	--	13.59	2.33
325-23	1060	0.848	--	1.55	.244	--	--	--	12.31	2.05
325-24	1060	0.830	--	1.59	.243	--	--	--	13.55	2.52
325-25	1060	(0.72)	--	1.60	--	--	--	--	--	--
325-26	1060	1.017	--	1.57	.285	--	--	--	12.72	2.92
325-27	1060	(0.93)	--	1.59	--	--	--	--	--	--
325-28	1066	0.844	--	1.61	.315	--	--	--	8.56	1.98
325-29	1066	(0.54)	--	1.51	--	--	--	--	--	--
325-30	1066	(0.80)	--	1.51	--	--	--	--	--	--
325-31	1066	0.768	--	1.45	.256	--	--	--	4.34	0.82
325-32	1066	0.791	--	1.52	.273	--	--	--	6.35	1.63
325-33	1066	0.878	--	1.51	.252	--	--	--	11.67	2.58
325-34	1066	(0.82)	--	1.45	--	--	--	--	--	--
325-35	1066	0.896	--	1.54	.320	--	--	--	7.47	1.70
325-36	1066	0.952	--	1.49	.239	--	--	--	10.41	2.16
325-37	1066	(0.81)	--	1.47	--	--	--	--	--	--
325-38	1066	0.839	--	1.53	.329	--	--	--	6.14	1.45
325-39	1066	0.907	--	1.50	.271	--	--	--	10.57	2.57
325-41	1066	0.766	--	1.51	.343	--	--	--	7.48	1.83
325-42	1066	0.802	--	1.53	.358	--	--	--	7.69	1.26
325-43	1066	0.772	--	1.59	.406	--	--	--	5.32	1.23
325-44	1066	0.724	--	1.54	.264	--	--	--	6.05	1.32
325-45	1066	0.817	--	1.51	.291	--	--	--	4.49	1.06
325-46	1066	(0.82)	--	1.54	--	--	--	--	--	--
325-47	1066	0.864	--	1.57	.270	--	--	--	10.9	1.98
325-48	1066	0.740	--	1.52	.383	--	--	--	5.25	1.16
325-49	1066	(0.85)	--	1.52	--	--	--	--	--	--
325-50	1066	0.864	--	1.58	.251	--	--	--	12.53	2.35
325-51	1066	0.897	--	1.56	.273	--	--	--	9.92	2.11
325-52	1066	(0.77)	--	1.54	--	--	--	--	--	--
325-53A	1066	(0.97)	--	1.51	--	--	--	--	--	--
325-54	1066	0.841	--	1.60	.285	--	--	--	6.4	1.3

Sample #	Temp.°C	$\rho_{app.}$ (g/cc)	He	ρ_{real} (g/cc) Xyl	Resis-tivity Ω-cm (×10)	Hard-ness (DPH)	Int. Frict. (×10³)	Sonic Mod. psi (×10⁻⁶)	Compr. Str. psi (×10⁻³)	Ult. Str. psi (×10⁻³)
325-55	1066	0.937	--	1.54	.211	--	--	--	14.94	2.9
325-55A	1066	0.708	--	1.46	.231	--	--	--	4.79	1.15
325-56	1066	0.984	--	1.48	.151	--	--	--	22.6	4.25
325-57	1060	0.853	--	1.57	.268	--	--	--	7.25	1.60
325-57A	1060	0.837	--	1.55	.277	--	--	--	8.67	1.62
325-58	1060	0.873	--	1.52	.301	--	--	--	5.5	1.25
325-58A	1066	0.839	--	1.52	.295	--	--	--	7.85	1.76
325-59	1066	0.696	--	1.52	.273	--	--	--	2.47	.54
325-59A	1066	0.719	--	1.60	.264	--	--	--	2.52	.65
325-59B	1066	0.815	--	1.50	.254	--	--	--	8.32	1.83
325-59C	1066	0.835	--	1.46	.247	--	--	--	10.98	1.81
325-60	1066	0.919	--	1.51	.250	--	--	--	9.01	1.85
325-60A/W	1066	0.864	--	1.52	.316	--	--	--	5.26	1.23
325-61	1066	0.919	--	1.50	.239	--	--	--	10.1	2.42
325-61A	1066	0.823	--	1.51	.252	--	--	--	7.06	1.95
325-61B	1066	0.867	--	1.48	.222	--	--	--	8.89	2.05
325-61C	1066	0.820	--	1.47	.282	--	--	--	5.9	1.31
325-61D	1082	0.838	--	1.44	.308	--	--	--	5.44*	1.42
325-61E	1082	0.834	--	1.49	.282	--	--	--	5.91*	1.33
325-62	1082	0.879	--	1.52	.221	--	--	--	13.10*	3.12
325-62A	1082	0.877	--	1.51	.237	--	--	--	8.69*	1.98
325-62B	1082	0.966	--	1.50	.179	--	--	--	6.71*	3.23
325-62D	1066	0.966	--	1.49	.249	--	--	--	13.81	2.79
325-62E	1066	1.027	--	1.45	.176	--	--	--	17.97	3.74
325-63	1066	0.954	--	1.50	.239	--	--	--	11.88	2.57
325-63A	1066	0.857	--	1.49	.229	--	--	--	11.93	2.35
325-63B	1066	0.892	--	1.47	.217	--	--	--	31.0 *	5.61
325-64	1066	0.880	--	1.45	.235	--	--	--	4.44*	2.03
325-64A	1066	0.991	--	1.51	.214	--	--	--	6.52*	3.19
325-64B	1066	1.068	--	1.49	.202	--	--	--	19.40*	4.62
325-64C	1066	0.945	--	1.46	.217	--	--	--	12.51*	2.51
325-64D	1066	0.931	--	1.43	.275	--	--	--	6.28*	2.52

*Head speed 0.2 in/min.

Sample #	Temp. °C	$\rho_{app.}$ (g/cc)	ρ_{real} (g/cc) He	ρ_{real} (g/cc) Xyl	Resistivity Ω-cm (×10)	Hardness (DPH)	Int. Frict. ($\times 10^3$)	Sonic Mod. psi ($\times 10^{-6}$)	Compr. Str. psi ($\times 10^{-3}$)	Ult. Str. psi ($\times 10^{-3}$)
325-65	1066	1.015	--	1.45	.161	--	--	--	40.24*	7.37
325-66	1066	1.063	--	1.46	.243	--	--	--	14.41*	3.52
325-66A	1066	0.995	--	1.50	.248	--	--	--	5.87*	2.79
325-66B	1066	0.994	--	1.48	.245	--	--	--	5.87*	2.99
325-66C	1072	1.030	--	1.46	.183	--	--	--	7.00*	3.02
325-66D	1054	0.723	--	1.52	.344	--	--	--	5.11*	0.98
325-67	1066	0.897	--	1.47	.242	--	--	--	9.47*	2.25
325-67A	1066	0.952	--	1.47	.209	--	--	--	39.40	6.14
325-67B	1066	0.976	--	1.52	.227	--	--	--	12.20	2.88
325-68	1072	0.962	--	1.47	.207	--	--	--	15.50	3.12
325-69	1054	0.974	--	1.50	.236	--	--	--	14.50	4.00
325-69A	1072	0.926	--	1.45	.224	--	--	--	9.19	2.77
325-69B	1054	0.975	--	1.49	.268	--	--	--	16.20	3.63
325-69C	1072	0.934	--	1.45	.333	--	--	--	11.50	3.12
325-69D	1054	0.984	--	1.52	.219	--	--	--	15.40	3.73
325-69E	1054	0.917	--	1.53	.274	--	--	--	10.50	2.58
326-1	1054	0.809	--	1.78	.265	--	--	--	4.58	0.75
326-1A	1054	0.774	--	1.78	.265	--	--	--	2.42	0.40
326-2	1066	0.724	--	1.80	.217	--	--	--	3.13	0.86
326-2A	1066	0.691	--	1.80	.328	--	--	--	3.10	0.77
326-3	1066	0.971	--	1.50	.206	--	--	--	13.08	2.13
326-3A	1066	0.894	--	1.49	.191	--	--	--	13.58	2.61
326-4	2000	(0.579)	--	1.99	--	--	--	--	--	--
326-4A	2000	(0.569)	--	2.17	--	--	--	--	--	--
326-5	2000	0.701	--	1.93	.383	--	--	--	1.73	0.27
326-5A	2000	0.710	--	1.98	.266	--	--	--	2.86	0.40
326-7	1066	(0.756)	--	1.95	--	--	--	--	--	--
326-8	1066	(0.658)	--	1.94	--	--	--	--	--	--
326-9	1066	(0.707)	--	1.94	--	--	--	--	--	--
326-10L	1066	(0.906)	--	1.62	--	--	--	--	--	--
326-11	1630	0.704	--	1.40	.237	--	--	--	6.53	1.00
326-12	1630	0.812	--	1.45	.129	--	--	--	20.04	3.33
326-13	1630	0.773	--	1.46	.124	--	--	--	16.03	2.92

*Head speed 0.2 in/min.

Sample #	Temp.°C	$\rho_{app.}$ (g/cc)	ρ_{real} (g/cc) He	ρ_{real} (g/cc) Xyl	Resistivity Ω-cm ($\times 10$)	Hardness (DPH)	Int. Frict. ($\times 10^{3}$)	Sonic Mod. psi ($\times 10^{-6}$)	Compr. Str. psi ($\times 10^{-3}$)	Ult. Str. psi ($\times 10^{-3}$)
326-14	1630	0.769	--	1.44	.143	--	--	--	12.11	2.48
326-15	1177	0.812	--	1.48	.186	--	--	--	12.97	2.71
326-16	1177	0.830	--	1.56	.170	--	--	--	11.45	2.77
326-17	1177	0.685	--	1.52	.197	--	--	--	22.32	3.69
326-18	1177	0.871	--	1.52	.178	--	--	--	23.16	3.99
326-22	1177	0.899	--	1.51	.155	--	--	--	19.41	4.01
326-25	1177	0.822	--	1.62	.237	--	--	--	35.12	4.51
326-26	1099	0.899	--	1.50	.134	--	--	--	35.12	5.86
326-27	1099	0.843	--	1.50	.192	--	--	--	11.95	2.76

TABLE 10 Physical Properties Correlated with Density

Sample #	$E_s/\rho_{app.}$ in$(\times 10^{-6})$	$\sigma_{cs}/\rho_{app.}$ in$(\times 10^{-3})$	$\sigma_{UTS}/\rho_{app.}$ in$(\times 10^{-3})$	$E_s\left(\frac{\rho_{real}}{\rho_{app.}}\right)$ psi$(\times 10^{-6})$	$\sigma_{cs}\left(\frac{\rho_{real}}{\rho_{app.}}\right)$ psi$(\times 10^{-3})$	$\sigma_{UTS}\left(\frac{\rho_{real}}{\rho_{app.}}\right)$ psi$(\times 10^{-3})$	$\rho\left(\frac{\rho_a}{\rho_{He}}\right)$ Ω-cm$(\times 10)$
310-35	--	252.4	49.2	--	18.8	3.67	--
311-34	--	333.3	325.9	--	--	--	--
311-35	19.2	37.2	66.9	--	--	--	--
312-13	--	1298.0	125.9	--	--	--	--
312-14	--	1000.0	--	--	51.8*	--	--
312-16	--	62.2	102.1	--	3.26	5.33	--
312-27	--	--	188.0	--	--	--	--
312-29	--	1030.6	--	--	56.4*	--	--
312-32	--	901.2	158.3	--	47.7*	8.38*	--
312-34	--	824.2	33.5	--	40.9*	1.09*	--
312-49	--	--	150.5	--	--	7.86	--
315-2	50.3	58.5	14.3	2.76*	3.2*	0.78*	.016*
315-14	--	1235.5	136.0	--	71.2*	1.04*	--
315-17	--	1030.0	88.3	--	--	--	--
315-20A	48.8	--	--	2.82*	--	--	--
315-20B	49.3	--	--	2.85*	--	--	.013*
315-20C	48.1	--	--	2.76*	--	--	.009*
315-21B	--	--	191.0	--	--	10.45	--
315-21C	45.8	1428.6	217.6	2.51*	78.2*	11.9*	.009*
315-21D	--	743.0	209.5	--	40.6	11.47	--
315-25A	--	767.0	145.5	--	38.9	7.39	--
315-25B	--	--	152.6	--	--	7.75	--
315-25C	48.8	1120.5	232.9	2.41*	56.9*	11.8*	.020*
315-26B	--	962.8	209.3	--	50.3	10.92	--
315-26C	41.7	888.9	147.2	2.18*	46.4*	7.7*	.003*
315-26D	46.2	1224.9	--	2.34*	63.9*	--	.009*
315-28	--	1079.3	127.0	--	56.7*	6.68*	--
315-31B	50.0	1218.8	178.8	2.63*	63.4*	9.4*	.007*
315-31C	49.3	--	--	2.63*	--	--	.015*
315-31D	48.8	1105.0	201.5	2.56*	58.1*	10.6*	.014*
315-32	--	1262.6	178.2	--	65.0*	9.2*	--

*Calculated with helium (otherwise with xylene).

Sample #	$E_s/\rho_{app.}$ in(×10^{-6})	$\sigma_{cs}/\rho_{app.}$ in(×10^{-3})	$\sigma_{UTS}/\rho_{app.}$ in(×10^{-3})	$E_s\left(\frac{\rho_{real}}{\rho_{app.}}\right)$ psi(×10^{-6})	$\sigma_{cs}\left(\frac{\rho_{real}}{\rho_{app.}}\right)$ psi(×10^{-3})	$\sigma_{UTS}\left(\frac{\rho_{real}}{\rho_{app.}}\right)$ psi(×10^{-3})	$\rho\left(\frac{\rho_a}{\rho_{He}}\right)$ Ω-cm(×10)
315-33	44.9	--	--	2.42*	--	--	.010*
315-34C	40.3	972.2	136.6	2.29*	55.3*	7.7*	.011*
315-34D	51.5	690.2	114.9	2.91*	39.0*	6.5*	.006*
315-37	31.9	744.2	131.6	1.70	39.7	7.01	.009
315-38A	35.9	925.9	114.6	1.95*	50.3*	6.2*	.011*
315-39A	51.5	1038.8	161.7	2.65	53.5	8.33	.013
315-39B	51.0	824.7	127.6	2.62	42.5	6.57	.002
315-41	--	612.8	--	--	31.1	--	.001
315-41A	48.7	671.0	72.2	2.93*	40.3*	4.3*	.002*
315-41B	45.9	563.0	69.9	2.69	33.8*	4.3*	.007*
315-42	52.7	--	--	2.79	--	--	.015
315-43	--	1335.5	--	--	71.1	--	--
315-44	52.1	--	--	2.69	--	--	.011
315-45B	211.9	--	--	12.74	--	--	.002
315-46A	--	2.78	2.48	--	4.4*	3.9*	--
317-1	--	1297.1	172.2	--	56.1	7.5	--
317-2	35.6	922.0	116.2	1.85	48.4	6.07	.009
317-5	--	1175.0	266.0	--	55.6	12.6	--
317-8	50.4	1120.9	63.4	2.62	57.6	3.30	--
317-9	--	964.8	172.3	--	61.1*	10.9*	--
317-10	50.9	1536.6	210.9	2.61*	78.5*	10.8*	.001*
317-12	--	--	181.6	--	--	10.5*	--
317-14	--	874.8	149.7	--	46.9*	8.03*	--
317-15	--	1025.6	124.8	--	53.9*	6.6*	--
317-18	33.0	126.0	104.0	1.51	8.93	5.78	.005
317-19	--	693.2	215.1	--	41.9*	13.0*	--
317-23	--	254.0	63.4	--	13.4	3.34	--
317-24	52.9	1794.6	159.7	2.99*	101.4*	9.0*	.009*
317-25	--	1076.4	89.9	--	54.6	4.57	--
317-26	53.7	167.4	32.8	2.86*	8.9*	1.7*	.010*
317-29	32.3	615.0	92.8	1.73	33.0	4.99	.006
317-32	51.3	1380.0	113.0	2.63	71.0	8.11	.014
317-33	--	1092.0	152.0	--	57.5*	8.0*	--

Sample #	$E_s/\rho_{app.}$ in(×10^{-6})	$\sigma_{cs}/\rho_{app.}$ in(×10^{-3})	$\sigma_{UTS}/\rho_{app.}$ in(×10^{-3})	$E_s\left(\frac{\rho_{real}}{\rho_{app.}}\right)$ psi(×10^{-6})	$\sigma_{cs}\left(\frac{\rho_{real}}{\rho_{app.}}\right)$ psi(×10^{-3})	$\sigma_{UTS}\left(\frac{\rho_{real}}{\rho_{app.}}\right)$ psi(×10^{-3})	$\rho\left(\frac{\rho_a}{\rho_{He}}\right)$ Ω-cm(×10)
317-34	88.4	1025.6	197.0	4.78	55.4	10.6	.014
317-37	49.8	1049.0	212.0	2.56	64.5	10.9	.014
317-38	31.1	1156.0	129.0	1.60	59.7	6.67	.017
317-39	43.3	963.0	129.0	1.98*	44.0*	5.9*	.002*
317-40	40.7	742.0	112.0	2.16*	39.4*	5.95*	.011*
317-41	--	298.0	70.0	--	17.1	4.0	--
317-41A	--	228.0	58.8	--	11.3	2.9	--
317-41B	--	668.0	96.5	--	35.7*	5.15*	--
317-42	49.1	1266.0	169.0	2.63*	66.3*	8.8*	.008*
317-43	--	462.0	76.0	--	23.4*	3.84*	--
317-44	44.6	903.0	70.4	2.43*	49.1*	3.83*	.0004*
317-45	--	1017.0	164.0	--	51.4*	8.3*	--
317-46	43.5	1183.0	215.0	2.32*	63.2*	9.7*	.006*
317-47	--	785.0	160.0	--	39.3*	8.05*	--
317-48	29.9	--	--	1.57*	--	--	--
317-49	30.8	385.4	104.2	1.67*	20.9*	5.7*	.018*
318-1	24.8	--	89.8	1.35*	--	4.9*	.009*
318-2C	25.0	1076.8	148.9	--	--	--	--
318-7	23.2	29.2	28.0	1.12	1.41	2.87	--
318-8	--	526.6	162.6	--	28.2*	8.7*	--
318-8A	--	936.4	--	--	50.23	--	--
318-9	--	792.8	150.2	--	42.8*	8.1*	--
318-11	45.3	--	155.0	2.58*	--	8.8*	--
318-14	14.6	170.9	29.9	.76*	9.0*	1.6*	.015*
318-16	42.3	831.0	118.0	2.26*	44.4*	2.3*	.017*
318-17	44.2	1246.2	163.0	2.66*	65.5*	8.51*	.019*
318-22	43.2	987.0	146.0	2.25*	51.5*	7.63*	.014*
318-24	42.5	--	--	2.35	--	--	--
318-24C	--	752.0	134.0	--	33.6	6.01	--
318-28	43.9	--	--	2.30*	--	--	.010*
318-29	--	10.1	32.2	--	.5*	1.7*	.008*
318-30	39.2	563.3	149.62	2.10*	30.2*	8.03*	--
318-31	6.8	80.3	9.6	0.33	3.96	0.47	.009

Sample #	$E_s/\rho_{app.}$ in($\times 10^{-6}$)	$\sigma_{cs}/\rho_{app.}$ in($\times 10^{-3}$)	$\sigma_{UTS}/\rho_{app.}$ in($\times 10^{-3}$)	$E_s\left(\frac{\rho_{real}}{\rho_{app.}}\right)$ psi($\times 10^{-6}$)	$\sigma_{cs}\left(\frac{\rho_{real}}{\rho_{app.}}\right)$ psi($\times 10^{-3}$)	$\sigma_{UTS}\left(\frac{\rho_{real}}{\rho_{app.}}\right)$ psi($\times 10^{-3}$)	$\rho\left(\frac{\rho_a}{\rho_{He}}\right)$ Ω-cm($\times 10$)
318-32	--	650.0	--	--	36.5*	--	--
318-33	46.9	1118.1	164.9	2.62	61.6	9.1	.053
318-34	--	742.0	125.0	--	38.9*	6.57*	--
318-35	46.9	831.0	144.0	2.41*	42.9*	7.4*	.070*
318-36	36.6	505.0	90.6	1.87*	25.7*	4.62*	.008*
318-37	65.7	773.0	117.0	3.50*	41.3*	6.3*	.007*
318-39	67.3	785.0	179.0	3.82*	44.5*	10.1*	.007*
318-45	67.6	--	--	3.34	--	--	.006
318-46	62.7	1149.0	200.0	3.35	60.5	10.5	.029
318-48	--	89.7	212.0	--	4.63*	10.95*	--
318-51	26.0	546.0	45.3	4.23*	28.2*	2.3*	--
318-52	46.2	486.8	69.9	2.35*	24.7*	3.55*	.093*
318-53	--	151.0	51.1	--	7.9*	2.7*	--
318-58	2.8	--	165.0	.15	--	9.3	.154
318-59	60.1	886.0	117.0	3.00	44.2	5.9	--
318-60	52.0	1055.0	222.0	2.7	54.1	11.4	.010
318-61	40.4	620.0	109.0	2.00	30.9	5.4	.029
318-62	--	1195.0	201.0	--	60.2*	10.1*	--
321-3	--	1130.0	203.0	--	64.1*	11.5*	.021*
312-6	59.5	1061.0	210.0	3.43*	61.3*	12.1*	.021*
321-8	45.6	1197.0	215.0	2.39*	63.1*	11.4*	.034*
321-9	--	1283.0	231.0	--	59.3	10.7	--
321-10	66.0	1207.0	238.0	3.18*	58.4*	11.5*	.009*
321-11	44.9	1184.0	151.0	2.36*	60.9*	7.77*	.076*
321-12	35.0	427.0	72.0	1.67*	20.3*	3.4*	.089*
321-13	48.7	1032.0	176.0	2.64	57.2	9.54	.007
321-15	--	994.00	173.0	--	56.1*	9.7*	--
321-16A	50.7	792.0	148.0	3.36*	52.6*	9.8*	--
321-17B	53.5	1089.0	155.0	2.71*	55.1*	7.9*	--
321-18B	80.1	1726.0	246.0	4.02	92.2	13.2	--
321-19A	58.4	1006.0	193.0	2.99	51.4	9.9	--
321-19B	49.9	1055.0	192.0	2.62	55.2	10.1	--
321-20B	--	1381.0	246.4	--	74.6*	13.3*	--

Sample #	$E_s/\rho_{app.}$ in($\times 10^{-6}$)	$\sigma_{cs}/\rho_{app.}$ in($\times 10^{-3}$)	$\sigma_{UTS}/\rho_{app.}$ in($\times 10^{-3}$)	$E_s\left(\frac{\rho_{real}}{\rho_{app.}}\right)$ psi($\times 10^{-6}$)	$\sigma_{cs}\left(\frac{\rho_{real}}{\rho_{app.}}\right)$ psi($\times 10^{-3}$)	$\sigma_{UTS}\left(\frac{\rho_{real}}{\rho_{app.}}\right)$ psi($\times 10^{-3}$)	$\rho\left(\frac{\rho_a}{\rho_{He}}\right)$ Ω-cm($\times$10)
321-21A	48.8	1344.6	187.6	2.54	70.2	9.8	.013
321-21B	53.6	1288.9	171.1	2.83	68.2	9.1	.014
321-22A	42.6	943.0	181.0	2.21	48.9	9.4	.018
321-22B	--	986.4	129.8	--	54.7	7.19	--
321-22C	42.6	1074.4	129.5	2.31	58.2	7.02	.011
321-22D$_4$	42.7	1013.9	154.9	2.27	53.8	8.23	.012
321-23	54.8	1565.0	194.0	3.4*	98.0*	12.2*	.008*
321-23A	47.5	1183.4	184.0	2.61	65.2	10.1	.017
321-23B	48.4	1222.8	171.0	2.51	63.4	8.88	.012
321-24	52.9	1297.1	173.0	3.06	74.9	10.0	.012
321-24A	30.6	1430.5	205.1	1.6	75.5	10.8	.009
321-24B	57.6	1170.8	175.5	3.1	62.4	9.4	.011
321-25A	26.9	1103.0	213.5	1.41	58.2	11.2	.006
321-26	--	1466.7	42.8	--	82.4	2.4	--
321-27	20.0	313.3	43.3	1.2*	17.1*	2.4*	.006*
321-29	46.0	1157.0	172.0	2.81	59.2	8.79	.012
321-31F	26.0	503.8	82.6	1.6	30.5	5.0	.052
321-31G	--	599.0	95.2	--	36.0*	5.7*	.011*
321-31J	34.9	687.0	121.0	1.87	36.8	6.5	.010
321-31P	36.1	777.0	111.9	1.63	35.1	5.1	.017
321-31Q	46.3	1143.8	175.9	2.56	63.2	9.73	.011
321-31R	27.0	388.0	58.9	1.45	20.8	3.15	.011
321-31S	44.1	1063.9	160.9	2.22	53.4	8.08	.012
321-32A	26.9	1049.0	111.7	1.45	56.6	6.03	.011
321-32B	27.4	1098.2	171.4	1.50	60.3	9.41	.012
321-32C	27.98	1245.5	183.8	1.52	67.5	9.96	.013
321-32D	44.8	--	--	2.38	--	--	.016
321-32D$_1$	6.59	--	--	0.35	--	--	.017
321-32E	45.9	1233.7	173.4	2.21*	59.28*	8.33*	.017*
321-32F	26.3	963.5	123.8	1.46	53.4	6.87	--
321-32G	45.45	926.5	131.98	--	--	--	--
321-33A	--	1171.9	175.5	--	59.7*	8.94*	.011*
321-33B	46.3	1666.9	208.0	2.46	88.53	11.05	.02

Sample #	$E_s/\rho_{app.}$ in $(\times 10^{-6})$	$\sigma_{cs}/\rho_{app.}$ in $(\times 10^{-3})$	$\sigma_{UTS}/\rho_{app.}$ in $(\times 10^{-3})$	$E_s\left(\frac{\rho_{real}}{\rho_{app.}}\right)$ psi $(\times 10^{-6})$	$\sigma_{cs}\left(\frac{\rho_{real}}{\rho_{app.}}\right)$ psi $(\times 10^{-3})$	$\sigma_{UTS}\left(\frac{\rho_{real}}{\rho_{app.}}\right)$ psi $(\times 10^{-3})$	$\rho\left(\frac{\rho_a}{\rho_{He}}\right)$ Ω-cm $(\times 10)$
321-34A	42.96	902.4	217.7	2.47*	51.8*	12.5*	.016*
321-34B	86.56	980.5	85.98	4.97	56.3	4.94	.011
321-34D	42.54	--	--	2.29	--	--	--
321-34E_1	26.8	1191.6	158.2	1.17*	52.1*	6.92*	.0298*
321-36A	--	--	61.3	--	--	3.19	--
321-36B	29.7	1303.7	187.0	1.45	63.6	9.12	.023
321-37B	17.6	231.9	45.7	0.955*	12.57*	2.48*	.0106*
321-37E	32.9	48.7	12.6	2.09	3.1	.802	.0198
321-37F	3.4	44.7	9.37	.192	2.52	.528	--
321-37Q	7.8	65.1	15.6	.46	3.8	.9	.014
321-39	23.7	224.1	43.2	1.37*	13.0*	2.5*	.012*
321-40	--	23.0	2.8	--	1.18*	.14*	.013*
321-42A	12.6	73.9	20.6	.65	3.83	1.07	.012
321-42B	8.5	48.7	17.9	4.6*	2.6*	.96*	.012*
321-43A	22.7	49.7	14.0	1.3*	2.8*	.79*	.017*
321-43B	4.5	33.1	9.1	.24*	1.7*	.47*	.019*
321-46B	5.4	69.1	16.6	.28*	3.6*	.85*	.015*
321-48B	11.4	88.7	20.0	.6*	4.6*	1.0*	.014*
321-50B	40.8	769.9	123.0	2.1*	39.5*	6.3*	.011*
321-51	20.5	255.0	38.2	1.1*	13.8*	2.1*	--
321-51A	--	--	--	--	--	--	.013*
322-1A	9.11	135.0	26.2	.52	7.76	1.5	.012
322-1B	8.67	--	--	.62*	--	--	.016*
322-3A	28.5	265.1	26.9	1.63	15.2	1.55	.008
322-11A	9.4	66.2	22.07	.50	3.56	1.19	.010
322-11B	9.23	30.4	6.5	.63*	2.09*	.45*	.010*
322-12A	12.1	112.2	12.1	.62	5.80	.62	.011
322-12B	13.3	77.3	9.1	.72	4.2	.49	.011
322-13A	20.9	144.0	--	1.1	7.55	--	.009
322-15B	19.9	238.9	--	1.07	12.8	--	.010
322-16B	12.4	140.9	29.1	.69	7.84	1.62	.011
322-17B	7.8	--	14.4	.42	--	.77	.018
322-18A	56.1	964.8	162.7	3.02	51.9	8.76	.006
321-45B	10.9	1083.6	155.0	.59*	58.7*	8.39*	.007*

Sample #	$E_s/\rho_{app.}$ in($\times 10^{-6}$)	$\sigma_{cs}/\rho_{app.}$ in($\times 10^{-3}$)	$\sigma_{UTS}/\rho_{app.}$ in($\times 10^{-3}$)	$E_s\left(\frac{\rho_{real}}{\rho_{app.}}\right)$ psi($\times 10^{-6}$)	$\sigma_{cs}\left(\frac{\rho_{real}}{\rho_{app.}}\right)$ psi($\times 10^{-3}$)	$\sigma_{UTS}\left(\frac{\rho_{real}}{\rho_{app.}}\right)$ psi($\times 10^{-3}$)	$\rho\left(\frac{\rho_a}{\rho_{He}}\right)$ Ω-cm($\times 10$)
322-19B	11.56	145.75	14.4	.65	8.16	.804	.014
322-20	27.3	317.6	50.7	1.55	18.0	2.88	.008
322-21	19.8	124.9	27.7	1.04	6.54	1.45	.011
322-22A	--	129.0	37.4	--	6.9	2.0	--
322-22B	--	161.7	37.0	--	8.71	1.99	--
322-23B	--	--	135.7	--	--	7.895	--
322-24A	--	--	40.7	--	--	2.22	--
322-24B	--	--	43.2	--	--	2.48	--
322-25A	52.7	782.0	109.4	2.82	41.8	5.85	.006
322-25A	46.6	619.0	68.25	2.76	36.7	4.04	.007
322-26	57.6	766.8	101.7	--	--	--	--
322-27A	52.7	831.7	87.7	2.7	42.7	4.5	.005
322-28A	--	547.6	94.0	--	28.5	4.89	.006
322-29A	28.5	445.4	68.36	1.5	23.5	3.6	.009
322-30	25.7	87.3	27.17	1.32	4.48	1.29	.011
322-31B	9.63	74.2	14.56	.55	4.24	.831	.015
322-32	13.5	114.5	17.4	.78	6.62	1.005	.011
322-33	23.4	108.2	51.46	1.37	6.33	3.01	.010
322-34	39.5	495.6	142.1	1.91	24.0	6.88	.007
322-35	24.4	424.2	63.62	1.26	21.9	3.29	.012
322-36	40.6	723.4	117.6	2.13	37.9	6.16	.006
322-37	16.7	131.2	41.8	.87	6.83	2.175	.011
322-38	35.37	423.1	93.65	2.14	25.7	5.68	.007
322-39	33.8	473.8	137.9	1.89	26.53	7.72	.007
322-40	39.9	488.74	120.9	2.29	28.1	6.94	.005
322-41	31.8	372.7	98.46	1.83	21.4	5.66	.008
322-42A_3	33.8	414.0	114.2	--	--	--	--
322-42A_4	29.4	601.1	43.25	--	--	--	--
322-42B_1	28.9	414.7	82.2	1.5	21.6	4.28	.009
322-42B_2	32.1	486.8	81.9	1.69	25.7	4.32	.009
322-42B_3	33.7	735.5	117.9	1.78	38.8	6.22	.0135
322-42B_4	29.36	511.6	44.9	1.6	27.9	2.45	.007
322-42B_5	30.9	588.2	101.76	--	--	--	--

Sample #	$E_s/\rho_{app.}$ in $(\times 10^{-6})$	$\sigma_{cs}/\rho_{app.}$ in $(\times 10^{-3})$	$\sigma_{UTS}/\rho_{app.}$ in $(\times 10^{-3})$	$E_s\left(\frac{\rho_{real}}{\rho_{app.}}\right)$ psi $(\times 10^{-6})$	$\sigma_{cs}\left(\frac{\rho_{real}}{\rho_{app.}}\right)$ psi $(\times 10^{-3})$	$\sigma_{UTS}\left(\frac{\rho_{real}}{\rho_{app.}}\right)$ psi $(\times 10^{-3})$	$\rho\left(\frac{\rho_a}{\rho_{He}}\right)$ Ω-cm $(\times 10)$
322-42B6	35.8	621.8	46.5	1.93	33.5	2.5	.010
322-45	22.95	228.2	68.86	1.43	14.2	4.28	.010
322-48	17.5	87.9	40.4	0.94	4.7	2.16	.013
322-49A	27.7	462.5	78.48	1.46	24.4	4.14	.008
322-50	21.2	269.57	216.6	1.17	14.8	2.87	.007
322-61	14.96	146.62	37.78	0.79	7.73	1.99	.010
322-62	34.9	475.7	89.95	1.88	25.6	4.84	.006
322-63	46.8	990.87	113.76	2.64	55.85	6.41	.005
322-63A	57.45	565.2	119.3	3.1	30.43	6.42	.005
322-64	54.23	1287.9	152.79	3.13	74.45	8.83	.005
322-64B	56.25	1157.7	176.5	3.27	67.34	10.27	.005
322-67	43.0	1006.2	158.25	2.55	59.6	9.38	.005
322-67B	44.9	941.7	151.2	2.29	47.97	7.7	.006
322-68	19.8	284.3	54.98	1.09	15.61	3.02	.009
322-68A	--	--	--	--	--	--	.009
322-69	16.8	208.6	47.73	0.9	11.3	2.59	.009
322-69A	16.1	201.7	53.05	0.86	10.4	2.82	.010
322-70	15.2	244.3	45.73	0.79	12.7	2.38	.011
323-2	40.8	947.4	153.65	2.14	49.6	8.05	.006
323-2A	45.0	916.8	141.8	2.34	47.7	7.38	.006
323-3A	60.7	1187.9	159.5	3.36	65.7	8.81	.005
323-4	19.5	305.2	66.7	1.04	16.2	3.54	.0093
323-4A	19.5	297.7	61.4	1.04	15.8	3.26	.0095
323-5	2.95	163.4	30.7	0.16	8.85	1.66	.0217
323-5A	2.99	155.3	36.1	0.158	8.19	1.91	.0213
323-7A	5.39	294.0	46.4	0.292	15.9	2.51	.0174
323-8A	7.75	580.1	122.6	0.426	31.9	6.7	.0126
323-9	8.33	338.3	83.3	0.454	18.46	4.54	.0132
323-9A	3.62	329.8	47.3	0.199	18.11	2.60	.0126
323-11B	2.84	192.3	36.3	0.153	10.35	1.95	.0225
323-11E	--	188.5	64.1	--	10.01	3.40	.0218
323-11F	2.207	148.5	31.4	0.121	8.15	1.72	.0211
323-12	6.39	282.9	55.9	0.353	15.63	3.09	.0129

Sample #	$E_s/\rho_{app.}$ in $(\times 10^{-6})$	$\sigma_{cs}/\rho_{app.}$ in $(\times 10^{-3})$	$\sigma_{UTS}/\rho_{app.}$ in $(\times 10^{-3})$	$E_s\left(\frac{\rho_{real}}{\rho_{app.}}\right)$ psi $(\times 10^{-6})$	$\sigma_{cs}\left(\frac{\rho_{real}}{\rho_{app.}}\right)$ psi $(\times 10^{-3})$	$\sigma_{UTS}\left(\frac{\rho_{real}}{\rho_{app.}}\right)$ psi $(\times 10^{-3})$	$\rho\left(\frac{\rho_a}{\rho_{He}}\right)$ Ω-cm$(\times 10)$
323-12A	5.74	171.8	71.5	0.313	9.37	3.90	.0145
323-13	9.54	381.0	66.7	0.527	21.1	3.69	.0118
323-13A	9.48	391.9	61.5	0.524	21.67	3.40	.0116
323-14		402.1	73.8		22.67	4.16	.0092
323-19	3.46	148.1	30.9	0.188	8.03	1.675	.022
323-20	9.12	1028.9	132.9	0.494	55.8	7.2	.0097
323-20A	8.77	675.1	153.2	0.476	36.6	8.3	.0102
323-21	6.92	352.6	91.2	0.355	18.1	4.68	.0129
323-22	9.33	883.4	161.2	0.502	47.6	8.68	.0103
323-23	7.69	287.5	62.1	0.381	14.2	3.07	.0126
323-25	1.43	142.6	28.9	0.077	7.68	1.56	.0258
323-25A	1.49	128.1	22.3	0.079	6.8	1.18	.0202
323-26	6.51	434.0	72.9	0.346	23.1	3.88	.0133
323-26A	6.23	386.9	76.4	0.329	20.4	4.03	.0137
323-27		371.0	84.8		19.4	4.44	.0319
323-28	6.16			0.318			.0145
323-28A	5.42	262.0	47.8	0.282	13.6	2.49	.0171
323-29		157.4	13.4		8.4	.71	.0307
323-31		310.9	69.2		15.3	3.4	.0123
323-32	5.99	312.9	75.2	0.316	16.5	3.97	.0147
323-32A	6.32		83.3	0.331		4.37	.0143
323-34		304.98	67.6		15.98	3.54	.0114
323-35A	7.07	316.8	68.9	0.368	16.5	3.58	.014
323-36A	3.3	224.7	102.9	0.175	11.9	5.5	.018
323-38	6.05	360.5	80.5	0.328	19.5	4.36	.014
323-38		332.1	79.9		18.4	4.42	.012
323-39	1.03	388.6	65.4	0.45	20.2	3.40	.012
323-40	3.13	336.1	66.1	0.312	17.9	3.51	.013
323-41		130.5	53.4		7.02	2.87	.015
323-43		298.8	34.6		15.98	1.85	.014
323-45	5.06	246.4	71.6	0.274	13.4	3.88	.015
323-46	5.95	337.2	84.9	0.325	18.4	4.63	.014

Sample #	$E_s/\rho_{app.}$ in$(\times 10^{-6})$	$\sigma_{cs}/\rho_{app.}$ in $(\times 10^{-3})$	$\sigma_{UTS}/\rho_{app.}$ in $(\times 10^{-3})$	$E_s\left(\frac{\rho_{real}}{\rho_{app.}}\right)$ psi $(\times 10^{-6})$	$\sigma_{cs}\left(\frac{\rho_{real}}{\rho_{app.}}\right)$ psi $(\times 10^{-3})$	$\sigma_{UTS}\left(\frac{\rho_{real}}{\rho_{app.}}\right)$ psi $(\times 10^{-3})$	$\rho\left(\frac{\rho_a}{\rho_{He}}\right)$ Ω-cm$(\times 10)$
323-47		284.4	101.9		15.2	5.45	.013
323-48	6.36	356.3	85.9	0.345	19.3	4.66	.013
323-50	8.72	1071	137.8	0.476	58.4	7.52	.009
323-54		308.1	56.3		16.1	2.95	.011
323-55	6.36	384.9	40.7	0.340	20.6	2.18	.013
323-56		432.1	77.9		22.6	4.08	.010
323-57	6.05	315.2	51.2	0.337	17.5	2.85	.013
323-58	4.32	257.8	70.1	0.240	14.3	3.9	.016
323-65	5.99	324.9	79.4	0.320	17.4	4.25	.013
323-66	6.46	244.5	76.6	0.347	13.16	4.12	.014
323-67	12.27	1189.9	209.7	0.643	62.34	10.99	.009
323-68		250.8	63.5		13.8	3.5	.016
323-69	5.57	248.1	70.1	0.299	13.36	3.77	.013
324-1	4.54	209.4	59.6	0.245	11.3	3.21	.015
324-2	5.68	223.5	46.6	0.297	11.71	2.44	.015
324-3	6.19	301.7	79.2	0.340	16.6	4.35	.013
324-4	10.9	704.5	136.1	0.599	38.7	7.48	.009
324-5	4.43	248.4	73.4	0.243	13.6	4.03	.014
324-6	4.61	249.8	90.1	0.255	13.81	4.98	.015
324-7	4.61	269.7	80.9	0.246	14.1	4.33	.016
324-8	4.86	269.7	77.7	0.267	14.8	4.27	.015
324-9		249.4	74.7		13.8	4.13	.015
324-11	8.98	806.8	122.2	0.496	44.6	6.75	.009
324-12	8.05	579.3	97.2				
324-13	9.62	938.8	153.2	0.521	50.9	8.30	.009
324-14	12.70	1190.9	192.7	0.651	61.1	9.89	.009
324-15	6.98	465.0	100.6	0.373	24.9	5.38	.010
324-16	10.24	836.4	127.3	0.799	44.4	6.76	.008
324-18	12.02	1179.8	174.7	0.678	66.5	9.85	.008
324-19	6.30	496.2	80.4	0.351	27.6	4.47	.012
324-20	5.34	476.8	65.6	0.287	25.67	3.53	.014

Sample #	$E_s/\rho_{app.}$ in $(\times 10^{-6})$	$\sigma_{cs}/\rho_{app.}$ in $(\times 10^{-3})$	$\sigma_{UTS}/\rho_{app.}$ in $(\times 10^{-3})$	$E_s\left(\frac{\rho_{real}}{\rho_{app.}}\right)$ psi $(\times 10^{-6})$	$\sigma_{cs}\left(\frac{\rho_{real}}{\rho_{app.}}\right)$ psi $(\times 10^{-3})$	$\sigma_{UTS}\left(\frac{\rho_{real}}{\rho_{app.}}\right)$ psi $(\times 10^{-3})$	$\rho\left(\frac{\rho_a}{\rho_{He}}\right)$ Ω-cm$(\times 10)$
324-21	12.93	1225.0	133.0	0.696	65.9	7.16	.008
324-21A	12.4	994.3	13.2	0.661	53.2	7.04	.009
324-22		718.7	115.0		40.2	6.44	.011
324-23	8.42	410.6	66.5	0.462	22.55	3.65	.013
324-24	7.16	439.8	67.1	0.401	24.6	3.76	.012
324-25A	9.06	933.1	131.8	0.367	37.8	5.33	.010
324-25B	1.44	110.3	15.5	0.077	5.94	.834	.034
324-25C	3.33	142.9	17.2	0.180	7.74	.932	.019
324-25D		699.2	147.2				
324-26	12.73	1240.8	157.8	0.708	69.04	8.78	.008
324-27A	3.47	196.8	37.0	0.192	10.9	2.05	.014
324-27B	.387	25.4	5.54	0.0218	1.43	.374	.035
324-27C		25.4	5.54		1.41	.308	.048
326-27D		20.8			1.15		.038
324-29	3.63	107.6	26.3	0.189	5.60	1.37	.015
324-32	4.46	154.7	57.4	0.248	8.61	3.20	.015
324-33	7.90	786.5	118.1	0.428	42.6	6.4	.009
324-34	8.41	602.4	109.6	0.477	34.2	6.2	.009
324-35	5.71	273.6	57.9	0.322	15.42	3.3	.013
324-37	6.04	229.1	58.2	0.319	12.1	3.07	.012
324-38	6.10	286.5	61.0		15.4	3.28	.014
324-39	5.35	248.8	62.6	0.292	13.6	3.41	.016
324-40A	3.27	149.3	31.7	0.181	8.25	1.75	.016
324-40D	.60	294.8	63.8				
324-40E	6.53	181.6	31.7	0.337	9.38	1.64	.012
324-41	5.91	314.1	72.8	0.320	17.0	3.94	.013
324-42	5.66	191.0	64.8	0.303	10.2	3.46	.012
324-43	7.64	334.4	97.2	0.425	18.6	5.41	.011
324-44	5.17	361.9	63.3	0.282	19.7	3.45	.012
324-45	8.12	361.0	104.4	0.446	19.8	5.73	.011
324-46	6.36	222.1	76.7	3.66	12.76	2.77	.01
324-47	5.01	180.2	45.1	0.271	9.77	2.44	.013

Sample #	$E_s/\rho_{app.}$ in $(\times 10^{-6})$	$\sigma_{cs}/\rho_{app.}$ in $(\times 10^{-3})$	$\sigma_{UTS}/\rho_{app.}$ in $(\times 10^{-3})$	$E_s\left(\frac{\rho_{real}}{\rho_{app.}}\right)$ psi $(\times 10^{-6})$	$\sigma_{cs}\left(\frac{\rho_{real}}{\rho_{app.}}\right)$ psi $(\times 10^{-3})$	$\sigma_{UTS}\left(\frac{\rho_{real}}{\rho_{app.}}\right)$ psi $(\times 10^{-3})$	$\rho\left(\frac{\rho_a}{\rho_{He}}\right)$ Ω-cm (×10)
324-48	6.02	291.8	74.3	0.346	16.8	4.27	.011
324-51	13.7	938.8	159.6	0.766	52.2	8.88	.008
324-52	6.09	266.8	58.1	0.33	14.5	3.15	.012
324-56	5.65	247.7	74.3	0.292	12.8	3.83	.014
324-57	11.98	572.2		0.632	30.18		.009
324-58	8.45	243.6	63.2	0.467	13.46	3.49	.011
324-61	10.91	331.07	92.9	0.572	17.34	4.87	.009
324-62	6.77	254.2	15.3	0.36	13.50	3.81	.013
324-63	7.57	287.8	56.8	0.413	15.7	3.10	.013
324-65	4.44	232.7		0.255	13.4		.014
324-66	2.61	132.9	30.8	0.147	7.49	1.74	.016
324-67	4.31	265.1	54.1	0.247	15.2	3.11	.014
324-69	4.26	226.7	46.5	0.236	12.5	2.55	.0146
324-70	4.20	224.2	51.2	0.235	12.6	2.77	.0139
324-71	5.71	242.7		0.287	13.5		.0135
324-72	2.31	101.5	20.8	0.129	5.68	1.12	.0163
325-1	9.44	977.8	111.7	0.518	53.7	6.1	.0094
325-5		254.3	49.4		14.1	2.75	.015
325-6		998.7	176.6		50.5	8.93	.018
325-7		333.9	83.4		18.5	4.6	.008
325-10C		251.1	57.8		13.8	3.18	.022
325-11		181.1	50.6		10.1	2.81	.020
325-12		324.4	36.0		19.5	2.16	.014
325-13		220.4	42.5		11.7	2.26	.010
325-14		299.8	60.4		16.1	3.25	.011
325-18A		285.7	55.9		16.0	3.13	.007
325-18B		249.8	55.8		13.8	3.09	.015
325-18C		279.7	61.2		15.9	3.47	.015
325-19A		320.7	64.8		18.4	4.45	.014
325-19B		314.7	65.6		17.7	3.69	.015
325-19C		326.7	62.3		17.7	3.49	.013
325-20		279.5	56.9		16.7	3.39	.016

Sample #	$E_s/\rho_{app.}$ in ($\times 10^{-6}$)	$\sigma_{cs}/\rho_{app.}$ in ($\times 10^{-3}$)	$\sigma_{UTS}/\rho_{app.}$ in ($\times 10^{-3}$)	$E_s\left(\frac{\rho_{real}}{\rho_{app.}}\right)$ psi ($\times 10^{-6}$)	$\sigma_{cs}\left(\frac{\rho_{real}}{\rho_{app.}}\right)$ psi ($\times 10^{-3}$)	$\sigma_{UTS}\left(\frac{\rho_{real}}{\rho_{app.}}\right)$ psi ($\times 10^{-3}$)	$\rho\left(\frac{\rho_a}{\rho_{He}}\right)$ Ω-cm($\times 10$)
325-21		358.7	71.7		19.96	3.99	.014
325-22		433.3	74.3		25.1	4.29	.012
325-23		401.8	66.9		22.5	3.75	.013
325-24		451.8	84.0		31.0	4.83	.013
325-26		346.2	79.5		21.3	4.51	.018
325-28		280.7	64.9		16.3	3.78	.017
325-31		156.4	29.6		8.19	1.55	.014
325-32		222.2	57.0		12.2	3.13	.014
325-33		367.9	81.3		20.1	4.44	.015
325-35		230.8	52.5		12.83	2.92	.019
325-36		302.7	62.8		16.3	3.38	.015
325-38		202.6	47.8		10.98	2.64	.018
325-39		322.6	78.4		17.49	4.25	.016
325-41		270.3	66.1		14.7	3.61	.017
325-42		265.4	43.5		14.7	2.40	.019
325-43		190.7	44.1		10.96	2.53	.020
325-44		226.3	50.5		12.6	2.81	.012
325-45		152.1	35.9		8.30	1.96	.016
325-47		349.2	63.4		19.8	3.60	.015
325-48		196.4	43.4		10.8	2.38	.019
325-50		401.4	75.3		22.9	4.30	.014
325-51		306.1	65.1		17.25	3.67	.016
325-54		210.6	42.8		14.5	2.47	.015
325-55		441.3	85.7		24.6	4.8	.013
325-55A		187.3	44.9				
325-56		635.7	119.5		33.9	6.4	.010
325-57		235.2	51.9		13.3	2.9	.015
325-57A		286.7	53.6		16.1	3.0	.015
325-58		174.4	39.6		9.6	2.18	.017
325-58A		258.9	58.1		14.2	3.19	.016
325-59		98.2	21.5		5.4	1.18	.013
325-59A		97.0	25.0		5.6	1.45	.012
325-59B		282.6	62.1		15.3	3.37	.014

Sample #	$E_s/\rho_{app.}$ in $(\times 10^{-6})$	$\sigma_{cs}/\rho_{app.}$ in $(\times 10^{-3})$	$\sigma_{UTS}/\rho_{app.}$ in $(\times 10^{-3})$	$E_s\left(\frac{\rho_{real}}{\rho_{app.}}\right)$ psi $(\times 10^{-6})$	$\sigma_{cs}\left(\frac{\rho_{real}}{\rho_{app.}}\right)$ psi $(\times 10^{-3})$	$\sigma_{UTS}\left(\frac{\rho_{real}}{\rho_{app.}}\right)$ psi $(\times 10^{-3})$	$\rho\left(\frac{\rho_a}{\rho_{He}}\right)$ Ω-cm$(\times 10)$
325-59C		363.9	59.9		19.2	3.16	.014
325-60		271.4	55.7		14.8	3.04	.015
325-60A/W		168.5	39.4		9.25	2.16	.018
325-61		304.2	72.9		16.5	3.95	.015
325-61A		237.4	65.6		12.9	3.6	.014
325-61B		283.8	65.8		15.2	3.52	.013
325-61C		199.1	44.2		10.6	2.35	.016
325-61D		179.7	46.9		9.35	2.44	.018
325-61E		196.1	44.1		10.6	2.38	.016
325-62		412.5	98.2		22.7	5.40	.013
325-62A		274.3	62.5		14.9	3.41	.014
325-62B		192.3	92.5		10.4	5.02	.012
325-62D		395.7	79.9		21.3	4.30	.016
325-62E		484.3	100.8		25.4	5.28	.013
325-63		344.7	74.6		18.7	4.04	.015
325-63A		385.3	75.9		20.7	4.09	.013
325-63B		461.9	174.1		51.1	9.25	.013
325-64		139.6	63.8		7.32	3.34	.014
325-64A		182.1	89.1		9.93	4.86	.014
325-64B		502.8	119.7		12.2	6.45	.014
325-64C		366.4	73.5		19.3	3.88	.014
325-64D		186.7	74.9		9.65	3.87	.018
325-65		1097.3	200.9		57.5	10.5	.011
325-66		375.2	91.7		19.8	4.83	.018
325-66A		163.3	77.6		8.85	4.2	.016
325-66B		163.4	83.3		8.74	4.45	.016
325-66C		188.1	81.2		9.92	4.28	.013
325-66D		195.6	37.5		10.74	2.06	.016
325-67		292.2	69.4		15.5	3.69	.015
325-67A		1145.5	178.5		60.8	9.48	.014
325-67B		345.9	81.7		18.9	4.49	.015
325-68		445.9	89.8		23.7	4.77	.014
325-69		412.0	113.7		22.3	6.16	.015
325-69A		274.7	82.8		14.4	4.34	.014

Sample #	$E_s/\rho_{app.}$ in($\times 10^{-6}$)	$\sigma_{cs}/\rho_{app.}$ in($\times 10^{-3}$)	$\sigma_{UTS}/\rho_{app.}$ in($\times 10^{-3}$)	$E_s\left(\frac{\rho_{real}}{\rho_{app.}}\right)$ psi($\times 10^{-6}$)	$\sigma_{cs}\left(\frac{\rho_{real}}{\rho_{app.}}\right)$ psi($\times 10^{-3}$)	$\sigma_{UTS}\left(\frac{\rho_{real}}{\rho_{app.}}\right)$ psi($\times 10^{-3}$)	$\rho\left(\frac{\rho_a}{\rho_{He}}\right)$ Ω-cm($\times 10$)
325-69B		459.9	103.0		24.8	3.72	.018
325-69C		340.8	92.5		12.3	4.84	.021
325-69D		433.2	104.9		23.8	5.76	.014
325-69E		316.9	77.9		17.5	4.30	.016
326-1		156.7	25.7		10.1	1.65	.012
326-1A		86.5	14.3		5.57	0.92	.011
326-2		119.7	32.9		7.78	2.14	.009
326-2A		124.2	30.8		8.08	2.01	.013
326-3		415.6	67.7		22.5	3.67	.012
326-3A		420.4	80.8		22.6	4.35	.011
326-5		68.31	10.66		4.76	0.74	.014
326-5A		111.49	15.59		7.98	1.12	.009
326-11		256.7	39.32		12.99	1.99	.012
326-12		683.08	113.51		35.79	5.95	.007
326-13		573.97	104.55		30.28	5.52	.007
326-14		435.86	89.26		22.68	4.64	.008
326-15		442.10	92.37		23.64	4.94	.010
326-16		381.82	92.37		21.52	5.21	.009
326-17		901.85	149.1		49.53	8.19	.009
326-18		735.96	126.79		40.42	6.96	.010
326-22		597.58	123.46		32.60	6.74	.009
326-25		1182.5	151.86		69.21	8.89	.012
326-26		1081.3	180.41		58.60	9.78	.008
326-27		452.89	90.62		24.54	4.91	.011