Abstract: The magnetization of ancient pottery and its potential for dating in archaeology

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When pottery is fired and subsequently cooled in the earth's magnetic field it acquires a moment which for fields $\lesssim$ 2–3 Oe is proportional to the intensity. It is possible to deduce this intensity from the magnetization. If the variation in intensity is sufficiently rapid it should be possible to use the information to refine a date for a piece of pottery. Values for the geomagnetic intensity in Athens between 2000 B.C. and A.D. 400 have been obtained from sherds excavated from wells and grave sites in the ancient Agora.[1] These data reveal fluctuations in intensity with values as high as twice the present day field in 600 B.C. and 450 B.C. The rate of change is sufficient to suggest the possibility of dating a piece of pottery to $\pm$ 30 years in some periods. Comparison of these data with that obtained by others for Central America and Japan indicate that the features are geophysical in origin. Thus, they may to some extent be used to predict the field at other locations on the earth's surface.

[1] D. Walton, Nature **277**, 643 (1979).

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Abstract: Application of the methods and concepts of magnetism to provenance determination of archaeological artifacts

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The magnetic properties of material artifacts depend on their bulk compositions, the phase assemblages, the crystal- and micro-structures of the phases and their thermal histories. The magnetic properties of an object formed from chemically pure elements and compounds are independent of the origins of the source materials. However, most archaeological artifacts are not made from pure elements and compounds and contain sufficient quantities of impurity atoms and ions to cause variations in magnetic properties that are traceable to variations in the impurity concentration of the source materials. Nevertheless, the relationship between the magnetic properties and provenance of an artifact reflects more than chemical composition. The utilization of data consisting of single numbers or low dimensional correlations among such numbers, i.e., as in chemical analysis, has severely hampered the progress of "sourcing" studies. The experimental techniques discussed overcome this limitation by providing data that are graphical and that include a large number of parameters as well as correlations among these parameters in a single measurement. These techniques include those of Mössbauer spectroscopy and temperature dependent magnetization studies. The data obtained in these two instances are graphical and exhibit simultaneously effects due to bulk composition, the phases present in a multiphase assemblage, crystal structure, magnetic structure, composition within a given phase and the microstructures of the phases. In many instances it is not necessary to perform extensive data analysis to establish a correlation between a possible source material and an archaeological artifact. The successful application of Mössbauer spectroscopy to provenance studies of iron ore artifacts from Mesoamerica will be discussed. It appears that this technique can also be extended to glass and a limited number of alloy artifacts. Thermomagnetic measurements have yet to be employed in provenance studies but the potential for application is clear.

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