



Magnetic granulometry as a provenance proxy of archaeological obsidian in the Mediterranean

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Reconstructing the distribution of ancient obsidian tools is a valuable way to trace ancient trade routes during the Neolithic. Such lithic material is in fact suitable for provenance investigations due to the rarity and diversity of volcanic sources where magma solidified as a vitreous rock. In the magmatic amorphous matrix of obsidian, in fact, crystal grains have variable compositions, distribution, and diameter. As some of them contain iron, their magnetic behavior can highlight changes in the amounts and sizes of the ferrous particles representative of different sources. As magnetic measurements are non-destructive, fast, and cheap, they gain advantage as an interesting alternative to the conventional trace element analysis. The affordability of magnetic measurements is here explored comparing the magnetic properties of 39 archaeological obsidians recovered in five Italian Neolithic sites (Brignano Frascata, Cascina Chiappona, Casalnoceto, Garbagna, and Castello D'Annone) spread along the river Tanaro in Piedmont to those of geological samples from Mediterranean islands (Lipari, Sardinia, Palmarola, Pantelleria, and Melos). Several magnetic parameters were investigated, namely: low field (χ) and anhysteretic (χ_a) susceptibility; saturation isothermal remanent magnetization at room (SIRM₂₉₃) and liquid nitrogen (SIRM₇₇) temperature; remanence (M_R) and saturation magnetization (M_S) as obtained from hysteresis cycles; anisotropy of low field susceptibility (P). The latter, P , was functional to discriminate between the sources of Lipari and Sardinia SA, both having large contents of superparamagnetic and single-domain grains, otherwise undistinguishable by standard magnetic analyses. Provenance was then attributed using graphic representations such as χ_a versus χ , and $Q_a = \chi_a/\chi$ versus $S_t = \text{SIRM}_{77}/\text{SIRM}_{293}$, which are affected by the relative amount of single domain (SD) and smaller paramagnetic grains, suitable to identify samples from most of the Mediterranean sites. Furthermore, cluster analysis was applied to the whole set of parameters, using the Euclidean distance between samples defined by the magnetic vectors after data normalization and establishing correlations with the volcanic sources when geological and archaeological samples fall in the same group. Using this procedure, most of the samples recovered from the Neolithic sites of Piedmont are attributed to Lipari as the most probable Mediterranean source with very few exceptions, confirming magnetic grain-size analysis as a useful approach in sourcing obsidian archaeological items in the Mediterranean region.