

Geochemistry and petrogenesis of volcanic rocks in the Lahrud region, of the Ardebil province, Iran

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Compositional analyses of materials from prehistoric contexts have become an important component of most scientifically oriented archaeological projects. Characterizing the elemental signature of materials (obsidian, metals, stones) helps determine provenance and technological production techniques, and therefore is useful for reconstructing trade and interaction between people prehistorically.

Simple petrographic descriptions can provide useful information on raw material provenance, but for some lithic materials more sophisticated techniques are required. Geochemistry can provide this sophisticated tool, trace and interpret the bedrock or the source of the ancient lithic materials. Geochemists have determined the geologic, magmatic and/or tectonic affinities of igneous rocks for decades. This project reports on mineral assemblages and whole-rock geochemistry that mafic rocks used to make lithic artifacts and especially building stones in the Ardebil province, northwestern Iran, have two bedrock sources.

New insights into the isotope exchange reaction between O₃ and CO₂ via O(¹D) from laboratory experiments

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Stratospheric CO₂ shows a marked oxygen triple isotope anomaly that is derived from O₃ via O(¹D). So far the precise isotopic composition of the isotope exchange partner of CO₂ has not been identified and it is not clear whether normal mass dependent or anomalous isotope effects contribute during the exchange process. From laboratory experiments using simultaneous mass spectrometric analysis of CO₂ and laser spectroscopy based symmetry selective analysis of O₃ isotopomers, we present experimental evidence that the O(¹D) mediated isotope transfer is coupled to the asymmetric O₃ isotopomers and follows a standard mass dependence. Recently investigated alternative pathways for oxygen isotope exchange between CO₂ and hyperthermal O atoms or O₂ molecules are unlikely to compete significantly with isotope exchange via O(¹D). Existing measurements also indicate unresolved discrepancies for the isotope anomaly of O₃ produced in the laboratory under different photochemical conditions, which may originate from highly energetic oxygen species generated in the photolysis of O₂ and/or O₃. Such variations would be directly transferred to CO₂, and further combined measurements of the isotopic composition of CO₂ and symmetry resolved O₃ are needed to fully unravel all aspects of the isotope exchange.