Petrology and geochemistry of volcanic rocks from NW of Iran: A case study from the archaeological sites

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Compositional analyses of materials from prehistoric contexts has become an important component of most scientifically oriented archaeological projects. Archaeologists are just beginning to explore various applications of the analytical technique for reconstructing prehistoric human behavior. In particular, trade and cultural exchange represent important but elusive pieces of information archaeologists gather about ancient peoples. Stone artifacts from building materials to lithic tools are commonly preserved at archaeological sites. To establish whether building stones (and/or artifact) had local or imported origins, an attempt was mede to include the geology of NW of Iran and rock samples for comparison. In some cases specific volcanic rocks have been identified with whole rock compositions so similar to building stone compositions.

Based on the discrimination and REE (chondrite normalized) diagrams together with mantle-normalized trace elements we can separate the lavas of bedrocks and archaeological sites into two groups: 1- the lavas with high-K calc-alkaline to shoshonitic affinity, enriched in LREE, Th, Ba, K, Pb and depleted in Ta, Nb. These lavas are related to younger, Plio-Quaternary volcanism, issued from an enriched mantle via low-degree of partial melting of a phlogopite bearing lherzolitic source. 2- The lavas with calc-alkaline to alkaline affinity with enrichment in LREE and depletion in Nb (for calc-alakline series). These lavas are essentially related to the Eocene volcanism of NW of Iran, originated from a post-collisional volcanism.

As a rule, the whole rock fingerprinting technique can be used to study the history of quarry use without actually excavating a quarry site. Volcanic rocks were probably the dominant material used in stone tools manufacture in NW of Iran. This may reflect the abundance and availability of volcanic rocks due to geologic factors. The effort required to transport large quantities long distances may have driven the preferential use of local materials.

New *in situ* zircon U-Pb age evidence for Archaean crust fragment in the heterogeneous Saharan Metacraton, Central North Sudan basement

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The heterogeneous nature of the Saharan metacratonic crust as evidenced from various isotopic and geochronologic data has already been shown [1]. In this paper, we report more evidence of this complex nature of the Saharan Metacraton in Central North Sudan and for the first time present *in situ* (i.e. primary host rock as opposed to detritic) zircon U-Pb age data that indicate the presence of Archaean fragments, (hitherto identified only in the Uweinat massif in Libya [2]), in Central North Sudan.

Central North Sudan basement comprises migmatite gneisses and associated granitoid melts that mark peak Pan-African age (600 Ma; [3]) orogenic formations, and ring complex granite suite (710-720 Ma; [3]), of the Neoproterozoic. Sr and Nd isotope data portray crustal sources for migmatite gneisses and associated granitoids and mantle sources for ring complex granites.

Our new zircon U-Pb data from a tonalite that forms part of an *in situ* TTG suite north of Delgo in Central North Sudan, give apparent $^{207}Pb/^{206}Pb$ Archaean ages of 2607-2821 Ma with discordia upper intercepts of 3013 ± 190 and 3025 ± 380 Ma. This *in situ* Archaean tonalite represents the presence of an Archaean crustal fragment and a probable source of detrital Archaean zircons in the region [4]. Together with the mostly Neoproterozoic formations in Central North Sudan, this Archaean fragment north of Delgo further indicates the complex-heterogeneous nature of the Central North Sudan basement [5], suggesting that the Saharan Metacraton made up of these exotic terranes was probably assembled during the Neoproterozoic [6]. Archaean formations may be evidence for the existence of a craton [7], or coherent continental crust [8], prior to Neoproterozoic time.

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