

APPENDIX 1

STONES USED IN THE QALAT SAID AHMADAN AND THEIR SOURCES

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On the virgin soils at the base of Operation A of Qalat Said Ahmadan site lie walls made from blocky stones. Most of such building stones excavated from the site are of marbles and metamorphosed silici-clastic sedimentary rocks (mainly pelites and psamites), except for two pieces found at the bottom of Operation A: one is purple-colored metabasalt, and the other is an ultramafic rock (probably, a dunite that is partly serpentinized) with black and smooth, naturally polished surfaces. Some silici-clastic wall stones from Operation A were cordierite-bearing biotite schists. Furthermore, a stone quern around 30 cm in diameter, made of gabbro, was excavated from an iron-age stratum (see the main text Fig. 7.7) of Operation A.

Qalat Said Ahmadan is located in a Quaternary basin of Qaladizah developed in the NW-SE-trending fold-belts of the Zagros range (Fig. 1). The basement rock of the Zagros range is exposed in the hills west of Said Ahmadan village and composed mainly of pelitic and calcareous metamorphic rock reported to be of Cretaceous to Jurassic ages (Fig. 1). The basement rock was covered by conglomerates of Quaternary river terraces and alluvial fans. Qalat Said Ahmadan was built on an alluvial fan that dips gently to the west. Pebbles and cobbles of the alluvial fan deposit are also composed mainly of pelitic and calcareous metamorphic rock, with minor amounts of fine-grained

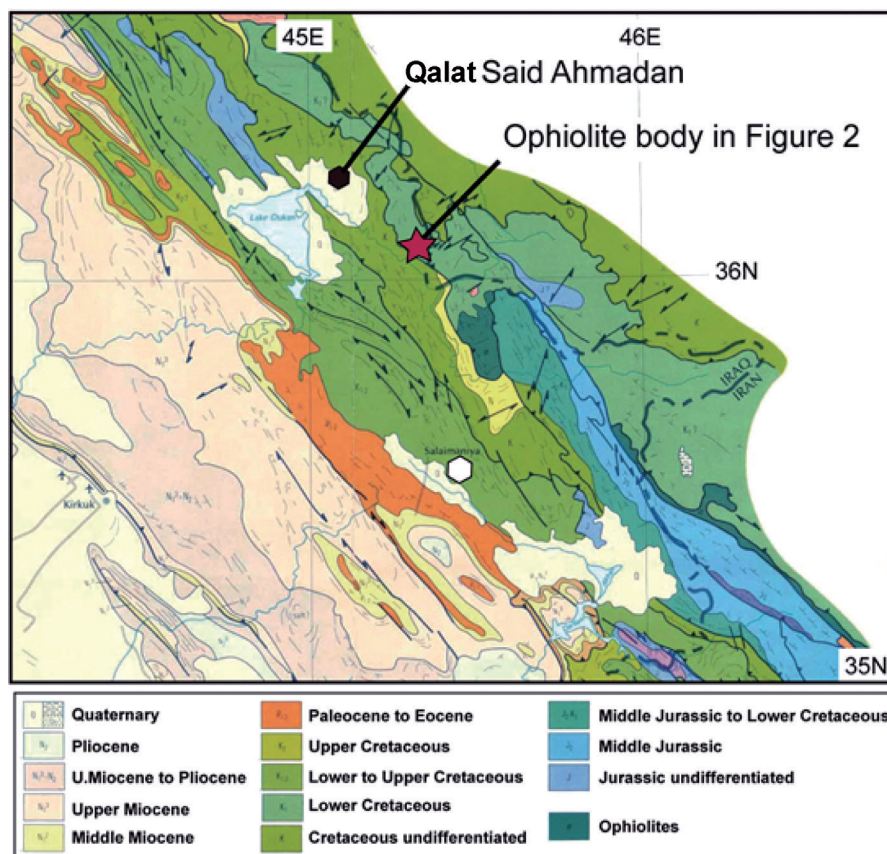


Fig. 1 Map modified based on “Geological Map of Iraq and Southwestern Iran”, Robertson Research (1987)

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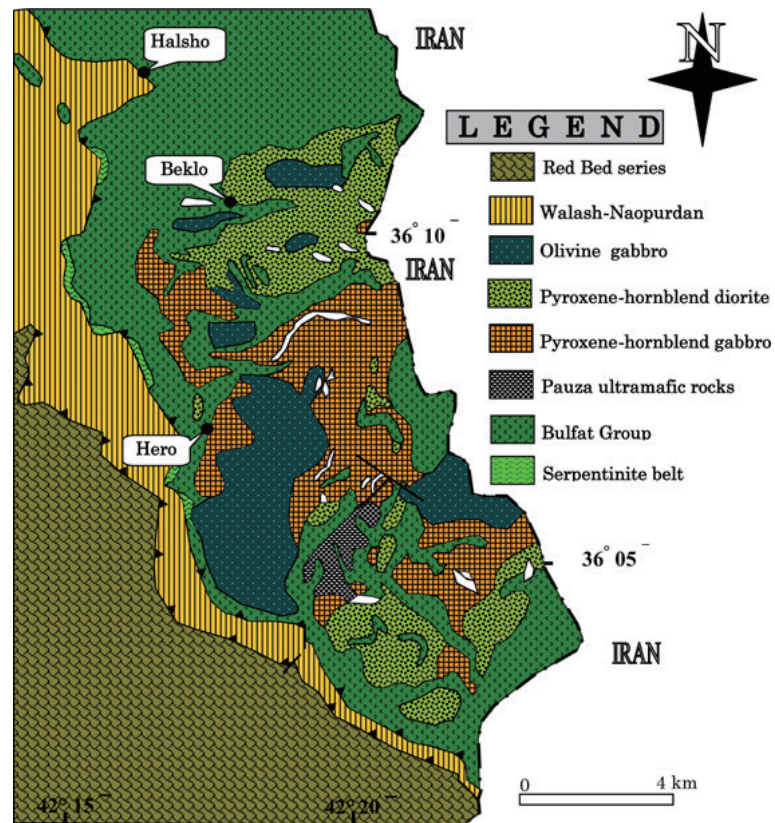


Fig. 2 Geology of the ophiolite exposed in the Hero area. The map was produced by Prof. Yousif Mohammad of the University of Slemani (Courtesy of Prof. Mohammad)

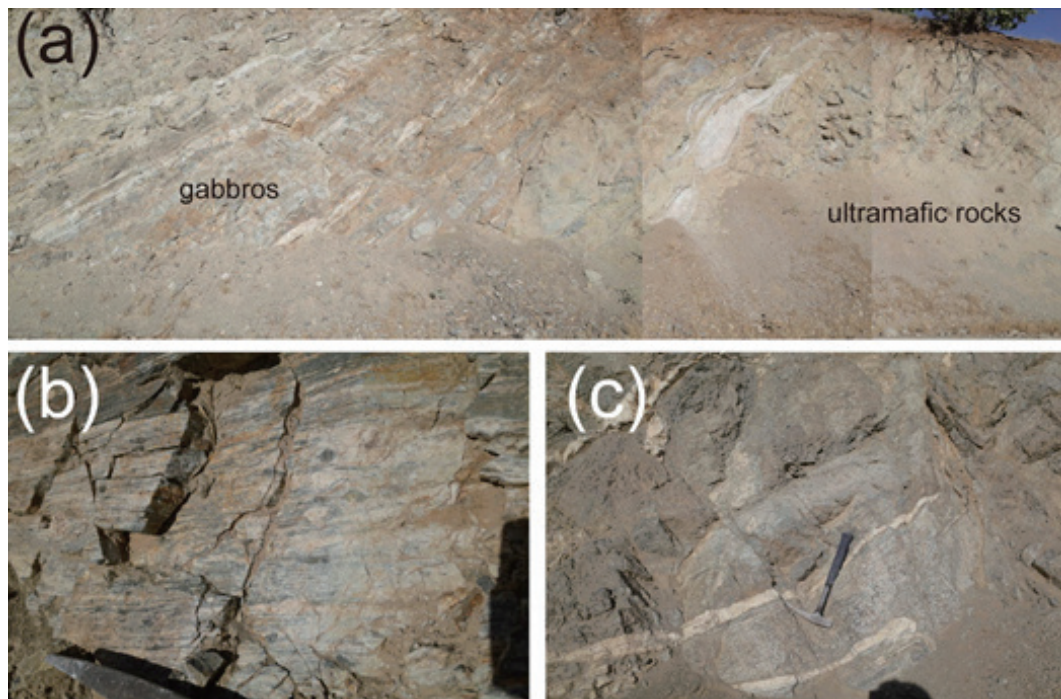


Fig. 3 (a) Boundary between the ultramafic rock and gabbro units of the ophiolite in the Hero area. Both deformed (b), and undeformed (c), gabbros were distributed

amphibolites and friable siltstones. These are very similar to the building stones used in Qalat Said Ahmadan. Thus, most of the building stones must have been mined from the basement and/or alluvial fan deposits. Because they are sub-rounded or sub-angular blocks, they are most likely mined from the fan deposits. However, no caliche was found in the building stones.

A few of the rock types found in Qalat Said Ahmadan, were not observed in the fan deposit. These included ultramafic rocks, gabbros and basaltic rocks. The assemblages of the missing rock types coincide with the fundamental components of ophiolitic rocks. Ophiolites are parts of oceanic crust now exposed on land, and they are commonly distributed along plate boundaries of the Arabian and Eurasian plates. They typically consist of, in ascending order, ultramafic rocks, gabbros, dolerites of sheeted-dike intrusions, and basaltic rocks, typically with pillow structures developed during sub-aqueous eruptions. The nearest known location of such ophiolite is in the Mawat region (the area marked in Fig. 1 by dark-green in the north of Slemani). The Mawat ophiolite is composed, in structurally descending order, of ultramafic rocks, gabbros, and pillow lavas; hence, the sequence is stratigraphically completely overturned [Aziz *et al.* 2011]. The geochemical characteristics of this ophiolite were reported by several authors [Mohammad 2008; Azizi *et al.* 2013]. More recently, a new record of ophiolite occurrence in the Hero area, in the southeast of Qaladizah, was reported by Prof. Yousif Mohammad of the University of Slemani. The approximate location is marked by a red star in Fig. 1, and a detailed geological map is shown in Fig. 2 (courtesy of Prof. Hohammad). The ophiolite in the Hero area is a part of the same tectonic unit as the Mawat ophiolite (Fig. 1). It is composed of a continuous sequence of ultramafic rocks and gabbros with various textures (Fig. 3), and dolerite and basaltic rocks. In the ultramafic-gabbro sequence, both lithologies are similarly interlayered and deformed, but the lithology sequence changes gradually from one to the other. The ophiolite stratigraphy seems normal from limited observation.

Both ophiolites have ultramafic rocks, gabbros, and microcrystalline basaltic rocks, and are located in the upstream portion of the Little Zab River. Thus, they are potential sources of the stones found in Qalat Said Ahmadan. The basaltic and ultramafic building stones were sub-angular to sub-rounded cobble, and the size of the gabbroic quern was ~30 cm in diameter. The rounded shape of the building stones implies that they must have been taken from a deposit of cobbles/boulders transported by the river. The large size of the building stones imply that the source was not far from their origin. Especially, the large core-stone from which the quern was made, is less likely to have been transported by the river from the Mawat ophiolite, and more likely from the ophiolite in Hero. Further petrochemical analyses are required to determine the place of origin of these materials. It is also noteworthy that such ophiolites commonly accompany radiolarian chert, which is commonly used for stone tools.

References

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