

Placer gold deposits in the Hofuf Formation The Eastern Province of Saudi Arabia

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Abstract:

Well-exposed, fine-grained to pebbly coarse-grained fluvial sandstone of Late Miocene to Pliocene age crop out in the Eastern Province (Hofuf and Haradh) of Saudi Arabia.. These sandstones belong to the Hofuf Formation, and were deposited largely in stream channels along Wadi As-Sahba over a distance of 450 kms. The graben structure of Wadi As-Sahba reflects a strike-slip motion that took place in the Plio-Quaternary. The evolution of the Hofuf formation is related to the tectonic evolution of the East Arabian Block in the Neogene's time. These sediments are immature as indicated by poor sorting and other mechanical parameters. They are derived from Precambrian basement and Phanerozoic rocks, which are mostly represented by granitic rocks in addition to lesser amounts of volcanics, metamorphic and sedimentary rocks. The sandstones comprise three distinct facies: clast-supported gravel and conglomerate, coarse-grained sandstone, and fine-grained sandstone. Sandstone compositions show a uniform framework composition dominated by monocrystalline quartz and feldspar with less abundant polycrystalline quartz, calcite, micas and igneous, metamorphic and sedimentary rock fragments. Quartz was derived mostly from plutonic source rocks. The heavy-mineral assemblage is characterized by abundant unstable minerals, particularly hornblende and pyroxene. The pebbles are granitic, metamorphic and sedimentary rocks derived from the Arabian platform. Modal compositions of the sandstones indicate a transitional provenance that ranges from continental to a craton interior and recycled orogen. The Lower gravelly unit of the Hofuf Formation in the Eastern Province is ~20 m thick and consists of at least 8 sedimentary cycles. Each cycle is composed of sandy gravel and conglomerate followed by coarse-grained-, and fine-grained arkosic sandstone. The gravels and conglomerates are rich in pebbles of various igneous and metamorphic rocks (granite, basalts, gneiss, schist, quartzite and amphibolites) derived from the gold-bearing Arabian shield as well as limestone, dolomite and marl derived from the Phanerozoic. Sixty representative samples were collected and sieved. The stream sediments of Al-Hofuf and Haradh areas, Eastern Province of Saudi Arabia, were studied for their content of gold. A geochemical signature of gold (placer) deposits was detected in the lower unit of the Hofuf Formation. Total sample from the Haradh fan were analyzed for gold. In the type section area, total samples as well as three fractions (400-250 Φ , 250-125 Φ , and <125 Φ)

of each sample were selected for gold analysis. The results show that the very fine-grained fraction ($<125 \Phi$) of the samples from the two upper cycles (TS-17 to TS-23, and TS-28 to TS-30) of the sand unit in the type-section area contains the highest amounts of gold (0.16-1.87 ppm). The coarse- and medium-grained fractions contain low amounts of gold (<0.1 ppm). Samples representing the lower cycles (TS-1 to TS-16) in the type section area contain only few amounts of gold (<0.1 ppm). Gold contents are highest in the first two upper cycles (TS-17 to TS-23, and TS-28 to TS-30) and decreases downward (TS-16 to TS-1).

Samples from Haradh area were collected from the surface the sample WS- a long a horizontal traverse. The samples represent only the uppermost cycle. The gold dispersion anomaly at the Haradh area, which occurs along the Wadi As Sahba, is of a high extent in three samples, representing three locations; The sample WS-19 contains the highest amount of gold (24.22 ppm), whereas the samples WS-1 and WS-3 contains 12.58 ppm and 4.83 ppm respectively. The rest of the samples contain only low amount of gold (<0.1 ppm). Samples representing the calcarenite and argillaceous sandstones from the second and third unit of the Hofuf Formation were collected from Jabal Qarah area. None of these samples contain gold. On mineralogical basis, the present work suggests that Al-Hofuf and the Haradh stream sediments represent a promising target for further geochemical exploration for precious metals, especially gold. Fire assay data indicate that placer gold in the studied sediments sometimes reaches 24 g/t. Background concentration of gold and variation in lithology suggest multiple source of the metal. The primary gold source of the Hofuf Formation is probably related to weathering of paleo-placers, and/or to weathering and transport of gold-bearing igneous rocks from the Arabian Shield. Placer gold is concentrated in the fine fraction ($< 125 \mu\text{m}$). It is recommended that exploration of gold in arid region must be directed essentially to the fine sized fraction.