# Hydrothermal alteration geochemistry of Atud gold deposits at the central block of the Egyptian Eastern Desert, Egypt: Insights provided by mass-balance calculations

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Atud gold deposit is mesothermal Au deposits hosted in gabbroic rocks at the central part of the Eastern Desert of Egypt. This deposit is structurally controlled by several sets of brittle-ductile shear zones and their gold mineralization are closely associated with intense hydrothermal alteration along these shear zones, with a typical greenschist facies alteration assemblages. The present study deals with geochemistry of hydrothermal alteration of Atud Au deposit in order to evaluate the material exchange as well as determine quantitative calculation of losses and gains of chemical components during hydrothermal alteration by determining the mineral assemblages of altered and parent rocks. Three main hydrothermal alteration zones of mineral assemlages that occurred around quartz veinlets associated with shearing have been described; zone 1 (sericite/kaolinite+sulfide±quartz±hematite), zone 2 (quartz+albite+kaolinite+sulfide±sericite) and zone 3 (carbonate+sericite+sulfide). Generally the altered wall rocks have high value of alteration degree (CIA=49.94, 52.18 and 47.78 for zone 1, zone 2 and zone 3 respectively) with slight change in chemical composition with reference to the least altered rocks (average 45.25). Mass balance calculations suggested that there is gain in $K_2O$ in zone 1 as a replacement of Fe-Mg silicate and feldspars by sericite. While, in zone 2, gain in $SiO_2$, $Al_2O_3$, $Na_2O$, and $K_2O$ refers to silicification, albitization and kaolinization alterations. On the other hand, zone 3 shows local gain in CaO reflects the occurrence of calc-silicate alteration. All alteration zones contain a large proportion of sulfide minerals (gain in $SO_2$) with increase in loss on ignition (LOI) as well as gold and related pathfinders (e.g. Au, Ag, Cu, As, Ba, Sb, and W) compared to the least-altered rocks. Furthermore, the sericitization index (3K/Al) is significantly higher in altered rocks (1.1 zone 1, 0.5 zone 2 and 1.1 zone 3) compared to least-altered rocks (0.2).

**Keywords**: Mass balance calculation, hydrothermal alteration geochemistry, Atud Au-deposit, Egypt.