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Characterization of host rocks and hydrothermal alteration of the Nuuluk gold occurrences in the Sermiligaarsuk Fjord area, South West Greenland

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Nuuluk is located about 75km SE of Paamiut, and gold exploration has been carried out since the early 70's (Appel & Secher 1984; Evans & King 1993). Exploration work at surface defined two ore horizons (Petersen & Madsen 1995), which were tested by Winkie and diamond drilling and better intersections yielded up to 2.3ppm of gold over 6m (Gowen 1994).
In this paper, we discuss new geological, petrographical and lithogeochemical data from the Nuuluk gold prospect with the aim to characterize the host rocks and hydrothermal alteration associated with gold mineralization. The rocks are metamorphosed to greenschist facies grade, comprise greenstone, quartz-feldspar-sericite-schist and carbonate altered metavolcanic rocks of Archaean age, which in turn were thrust over an Archaean gneiss basement to the east. The Nuuluk area comprises two distinct NNE striking, 40 to 60 degrees WNW-dipping, 50 to 100m thick and 5km long zones containing gold mineralization and hydrothermal carbonate-sericite alteration (Petersen & Madsen 1995). The distance between the two zones is about 500m and both zones are intimately associated with thrust contacts. The western carbonate zone was studied from a 60m long surface profile, which comprises hydrothermal altered greenstones consisting of ankerite-muscovite-chlorite-pyrite-arsenopyrite, narrow quartz veins and minor magnetite and graphite schist. A three meter thick layer of brownish sericite-ankerite schist yielded up to 900ppb Au. The eastern carbonate zone was studied from a 130m long surface profile and the lithologies comprise mainly massive and hydrothermal carbonate altered greenstones. A narrow 15cm quartz vein rimmed by thin ankerite alteration yielded up to 1300ppb Au. The hydrothermal alteration is similar in both zones, but in the eastern carbonate zone magnetite and graphite schists are lacking.
Application of immobile-element methods show that the rocks from both zones are mainly tholeiitic basalts with flat REE patterns and only few metavolcanic rocks mainly from the western carbonate zone are transitional to mildly calc-alkaline. The mafic metavolcanic rocks can be grouped based on their distinct immobile element ratios into 8 chemical rock groups ranging from basalt A to basaltic andesite I. Host rocks of the Au zone of the western carbonate zone are of basaltic andesite I type and define a good geochemical marker horizon. The same basaltic andesite I rocks occur in the eastern carbonate zone but with only slightly elevated gold contents.
Rocks from Nuuluk show a distinct gold-silver correlation, however the silver contents are low (below 10ppm). Although gold shows only weak correlation with arsenic and copper a halo of elevated As and Cu occurs in the gold zone which suggests that the fluids which have introduced the gold were also enriched in As and Cu.
Mass change calculations reveal that the hydrothermal alteration from the western carbonate zone is characterized by large gains of K, losses of Na and moderate gains of CO2, whereas the alteration seen from the eastern carbonate zone is characterized by moderate gains of K, Si, Na, and large gains of Fe and CO2.
This investigation shows that the gold zones occur in two ore horizons with different lithologies and alteration systems. Gold of the western carbonate zone is hosted in an alteration zone comprising proximal sericite and medial carbonate-chlorite altered metavolcanic rocks. In the eastern carbonate zone gold is hosted in Qtz veinlets. Both gold zones show typical characteristics which are similar to those of typical greenstone hosted orogenic gold deposits. At Nuuluk the gold zones are confined to high-strain zones intimately associated with thrust contacts confirming a structurally controlled load gold origin (Petersen & Madsen 1995).

References:

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