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Peculiar Mineralogical and Chemical Evolution of Contaminated Igneous Rocks at a Gabbro-Carbonate Contact, Wadai Bayhan, Yemen

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Abstract : The Wadi Bayhan area of southeastern Yemen is about 60 km NW of Al-Bayda city in the Al-Bayda uplift terrane at the southeast margin of the Arabian-Nubian Shield. Intrusion of alkali gabbro into carbonate rocks apparently produced an 8m to 10 m thick reaction zone at the contact. This had been identified as nepheline pyroxenite. We have observed this to be mineralogically zoned with calc-silicate assemblages (e.g. pyroxene, calcite, spinel, garnet and melilite). The presence of melilite implies a skarn. The sinuous embayed pyroxenite-skarn contact, the presence of skarn minerals in pyroxenite, and textural evidence for growth of calc-silicate skarn by replacement of both carbonate rocks and solid pyroxenite indicate that reaction involved assimilation of carbonate wall rock by magma and loss of Al and Si to the skarn. Textural relationships between minerals provide evidence for a metasomatic development of the skarn at the expense of the pyroxenite. This process, related to the circulation of fluids equilibrated with carbonates, is responsible for those pyroxenite-spinel (± calcite) skarns. The uneven modal distribution of euhedral pyroxenite and enveloping nepheline in pyroxenite, the restricted occurrence of alkali gabbro as dikes in pyroxenite and skarn and the leucocratic matrix of pyroxenite suggest that pyroxenite represents an accumulation of titanaugite cemented by an alkali-rich residual magma and that alkali gabbro represents a part of the residual contaminated magma that was squeezed out of the pyroxene crystal mush. Carbonate assimilation is modeled by reaction of calcite and magmatic plagioclase, which results in resorption of plagioclase, growth of pyroxene enriched in Ca, Fe, Ti, and Al, and solution of nepheline in residual contaminated magma. The composition of nepheline pyroxenite evolved by addition of Ca from dissolved carbonate rocks, loss of Al and Si to skarn, and local segregation of solid pyroxene and alkali gabbro magma. The predominance of pyroxenite among contaminated rocks and their restriction to a large zone along the intrusive contact provide little evidence for the genesis of a significant volume of alkaline magmatic surroundings by carbonate assimilation.

Keywords : Yemen, Wadi Bayhan, skarn, pyroxenite, carbonatite, metasomatic
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