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Petrology of the Mafic-Ultramafic Viravira Complex, Colombia: Fragments of an Alaskan-type Intrusion

C. Grimm (1), A. von der Handt (1), R.B. Schmidt (1), G. Laukert (2), and J. Mojica (2)

(1) Mineralogy-Geochemistry, Albert-Ludwigs University, Freiburg, Germany (christian-grimm@gmx.de), (2) Extracon, Choco, Colombia

Alaskan-type complexes (ATC) are of great scientific and economic interest due to their peculiar internal structure and composition and their primary magmatic enrichment in platinum-group elements (PGE). Characteristics of ATC are their concentrically zoned structure with a dunite core and increasing clinopyroxene-content towards the rim, their high Fe3+-content in spinels, indicating conditions at high oxygen fugacity, and the absence of orthopyroxene.

The Viravira complex is located at the western flank of the western Cordillera in the Chocó Department, Colombia. It consists mainly of high-MgO basalts and several isolated, partly serpentinized peridotite lenses [1]. Approximately 10 km E-NE of these lenses, the Alto Condoto ultramafic-mafic complex, the youngest ATC reported up to date (20 Ma, [1]), emplaced into the Viravira basalts and their sedimentary cover. Cross-cutting relationships, resorption textures and relative ages of overlying sediments indicate a close time-relation between the Viravira unit, including the peridotite lenses, and the Alto Condoto complex [1]. The scope of this study is to further investigate the genetic relationship between the Viravira and Alto Condoto complexes.

The Viravira samples were taken during a field campaign which was conducted in 2011. The sampled lithologies cover basalts, dunites, wehrlites, olivine-clinopyroxenites, clinopyroxenites, hornblende-clinopyroxenites, gabbros, hornblende-gabbros and breccias. All lithologies indicate a complex formation history based on mineral zoning, overgrowth and exsolution textures.

The porphyritic basalts are dominated by zoned clinopyroxene phenocrysts, which occur as single idiomorphic crystals or as aggregates. Frequently, the phenocrysts are intensively fractured. Olivine occurs only subordinately within the basalts and is often chloritized. Within the ultramafic rock lenses, olivine is invariably serpentinized whereas clinopyroxene is fresh. Xenomorphic, coarse-grained clinopyroxene is visibly unzoned, in contrast to clinopyroxene phenocrysts in basalts and gabbros. Poikilitic clinopyroxene enclosing olivine chadacrysts is common. Traces of biotite occur in most of the clinopyroxene-rich rocks. Fresh, zoned plagioclase is present in the hornblende-gabbros, which also contain some titanite and apatite. Hornblendes of these rocks show reaction rims filled with minute magnetite crystals, indicating disequilibrium with the melt. Plagioclase in the true gabbros is almost invariably altered and shows symplectitic overgrowth in places. Apatite is a common phase within the gabbros.

Fe-Cu-Ni-Co sulfides are present in traces in almost all rock samples but can locally reach as much as 2-3 vol%. Oxides show high Fe3+-contents and often exhibit exsolution textures. Spinels in dunites and basalts contain the most $Cr2O_3$, while those in clinopyroxenites and gabbros are richer in $Fe2O_3$. Magnetite exsolutions in clinopyroxene can be observed frequently.

The overall mineralogy and the high Fe3+-content of the spinels clearly suggest an ATC character. Oxide compositions match fairly well with those of the neighboring Alto Condoto complex, indicating an origin from a common parental melt.

[1] M. Tistl et al., Origin and emplacement of Tertiary ultramafic complexes in northwest Colombia: Evidence from geochemistry and K-Ar, Sm-Nd and Rb-Sr isotopes, EPSL 126, 41-59, 1994.