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CHROMITE CHEMISTRY AND PLATINUM GROUP MINERALS AS PETROGENETIC AND TECTONIC INDICATORS FOR ULTRAMAFIC ROCKS WITH ALASKAN-TYPE AFFINITIES FROM THE ATTAPADI VALLEY OF BHAVANI SHEAR ZONE, SOUTHERN INDIA

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The Attapadi valley, in southern India represents the western termination of the ENE-WSW trending Bhavani Shear Zone which preserves evidence for a Neoarchean convergent margin setting [1]. The shear zone contains highly deformed Archean TTG gniesses, volcano-sedimentary rocks and ultramafics. Dismembered Neoarchean suprasubduction zone ophiolites have been recently reported from the area , e.g. Santosh et al. [2]. The ultramafics are sheared and deformed, but in places preserve crude zoning in the form of peridotitic core enveloped by wehrlite, hornblende-clinopyroxenite and minor gabbro. They are medium to coarse-grained and preserve relict cumulate texture in places. Geochemically, these rocks are high in magnesium and have boninitic to Island arc- tholeiite signatures. Deformed chromitite bodies in these ultramafics contain inclusions of various Platinum Group Minerals (PGM).

We present detailed textural and mineralogical data of chromite, PGE and associated host rock from the Attapadi valley of Bhavani Shear Zone to show that these rocks could represent Archean analogues of Alaskan type intrusives. Chromite cores from the chromitite preserve magmatic composition despite high grade metamorphism. The Cr_2O_3 contents range from 36 to 43 wt.%. They are characterized by moderately high Cr # [i.e. Cr/(Cr+Al)] ranging from 0.67 to 0.81 and low to moderate Mg # [i.e. $Mg/(Mg+Fe^{2+})$] ranging from 0.15 to 0.33 and low to moderate TiO_2 contents ranging from 0.42 to 3.69 wt.%. They have low Al_2O_3 content (< 13 wt. %) and high Fe^{2+} (Fe^{2+} + Mg) values (0.68-0.85). These features are typical of Alaskan type intrusions in volcanic arcs [3]. Their lower Mg# and high FeO contents are also similar to stratiform chromite from layered intrusions rather than podiform chromite associated with ophiolites.

PGM inclusions (< 30 micron) identified within chromite are braggite (PtPdNi)S, laurite (RuOs)S, ruarsite (Ru,Os)AsS, irarsite (Ir,Ru,Rh,Pt)AsS and possible cooperite (PtS). Euhedral shapes of the PGM inclusions, with straight and curved crystal margins indicate that they formed by primary magmatic crystallization. Association with basemetal sulphides and absence of PGE alloys indicate that the magma had attained sulphur saturation. The higher number of (Pt + Pd + Rh) minerals when compared to (Os + Ir + Ru) minerals is suggestive of stratiform affinity rather that podiform chromites of ophiolitic origin. Presence of cumulus pyroxene (enstatite and diopside) and hornblende indicate their primary nature. The high wollastonite component of the diopside (46 to 49%), low Al_2O_3 (< 3.5 wt.%) and TiO_2 (< 0.45 wt.%) are identical to diopsides from ultramafic rocks in Alaskan type complexes [4]. Primary hornblende is consistent with an inferred water-rich subduction zone tectonic setting. Chromite chemistry, PGE mineralogy and clinopyroxene and hornblende compositions of the ultramafic rocks in

Attapadi are similar to typical Alaskan type intrusive complexes worldwide which are widely considered to represent root-zones of arc volcanics. Presence of Alaskan-type rocks in the Bhavani Shear Zone provides new evidence for a Neoarchean convergent margin setting. This also has implications for exploration for PGM and other associated mineralization in the area.

References:

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