Ore Geology Reviews 90 (2017) 148–165

Contents lists available at ScienceDirect

Ore Geology Reviews

journal homepage: www.elsevier.com/locate/oregeo

# Metasomatic alteration of chromite from parts of the late Archaean Sittampundi Layered Magmatic Complex (SLC), Tamil Nadu, India

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ARTICLE INFO

*Article history:*
Received 5 August 2016
Received in revised form 5 May 2017
Accepted 22 May 2017
Available online 26 May 2017

*Keywords:*
Archaean chromites
Metamorphism
Element mobility
SLC

ABSTRACT

Chromite deposits associated with layered anorthosite complexes in the Archaean high-grade terranes are rare in the world. The late Archaean Sittampundi Layered Magmatic Complex, Tamil Nadu, India is one of the few such deposits in the world where layers of Fe-Al rich chromites are associated with extremely calcic (An>95) anorthosite. 'Frozen in' magmatic mineralogy of the chromitite and the enclosing anorthosite suggest successive crystallization of chromite + clinopyroxene and chromite + clinopyroxene + anorthite from a hydrous Al-rich basaltic melt that was emplaced in a suprasubduction zone setting. Intense deformation and upper amphibolite facies metamorphism at ~2.45 Ga converted the magmatic assemblages to hitherto unreported hornblende + gedrite + Mg-Al rich spinel ± chlorite bearing assemblages. During metamorphic reconstitution, chromite was pseudomorphically replaced by green spinel in the domains rich in secondary amphiboles. Mass-balance calculation and algebraic analyses of the observed mineralogy suggest that a number of chemical species including chromium became mobile during the formation of spinel pseudomorph in response to infiltration driven metamorphism. Aluminium became mobile in the length scale of chromite grain but remained immobile in the length scale of a thin section.



## 1. Introduction

Compositional variation of chromite is an important fingerprint to trace the composition of the parental magma from which it was formed, the tectonic setting where the parental magma was emplaced and the intrinsic physicochemical conditions that prevailed during post-solidification changes (reviewed in Ashwal, 1993; Barnes and Roeder, 2001; Berger et al., 2013; Rollinson et al., 2002). Chromitite associated with the metamorphosed layered magmatic complexes of the late Archaean age show unique compositional features (Fe-Al rich chromite associated with anorthite) that distinguish them from the other chromitite deposits that are reported from diverse tectonic settings and over a protracted period of time (Table 1), reviewed in Berger et al., 2013; Dutta et al., 2011; Rollinson et al., 2010, 2002). Preliminary studies from one place of the late Archaean Sittampundi Layered Magmatic Complex (here after SLC) show that SLC is one of such rare occurrences where unusually Fe-Al rich chromite are hosted in ultracalcic anorthosite (Dutta et al., 2011). During superimposed metamorphism at significantly different physicochemical conditions than those prevailed during the magmatic stage, chromite-bearing assemblages underwent compositional and textural changes to restore equilibrium in a new set of conditions (reviewed in Barnes and Roeder, 2001; Rollinson et al., 2010, 2002). Commonly, chromite shows an increase in $Fe^{3+}/(Fe^{3+} + Fe^{2+})$ ratio at constant or variable Cr# ($Cr^{3+}/(Cr^{3+} + Al^{3+})$, reviewed in Barnes and Roeder, 2001; Berger et al., 2013; Mukherjee et al., 2010). Compared to these deposits, chromite shows enrichment in Al and Mg in some deposits (Berger et al., 2013; Candia and Gaspar, 1997; Rollinson et al., 2002). The exact mechanism that triggered the Al-Mg enriched trend in magmatic chromite is poorly understood so far (Berger et al., 2013; Rollinson et al., 2002). Such compositional trend in metamorphic terranes also offers unique opportunity to study the behaviour of Cr and Al during infiltration driven metamorphism.

In this communication we trace the compositional evolution of the rare Fe-Al rich chromitite bands that are enclosed within the highly calcic anorthosite of the late Archaean SLC. Interpreting the vestiges of magmatic assemblages that are preserved in the studied rocks, it is suggested that the magmatic protoliths of the SLC were formed from a hydrous Al-rich basaltic melt that was emplaced in a suprasubduction zone setting. Intense deformation

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http://dx.doi.org/10.1016/j.oregeorev.2017.05.021
0169-1368/