A NEW MODEL INVOKING SORET EFFECT FOR THE ORIGIN OF Fe-Ti OXIDE DEPOSITS ASSOCIATED WITH THE PROTEROZOIC ANORTHOSITES

A.S.P. Rao[1,2], and K. Srinivas[3], [1] Dept. of Geology, Osmania Univ., Hyderabad - 500 007, India. [2] B5, Ravi Apts, Saroornagar, Huda Complex, Hyderabad - 500 035, India (Address for Correspondence), [3] Dept. of Geology, Kakatiya Univ., Warangal -500 009, India

The authors propose that Fe-Ti oxide deposits that occur in association with a large number of Proterozoic anorthosite massifs are due to Soret diffusion of Fe, Ti and P from the magma towards the cold margins of the massif. Soret effect has geologically observable magnitude (1).Fe-rich dioritic rocks (Jotunites and monzonorites) occur widely in association with anorthosite massifs as small bodies along the margins of anorthosite. Fe- rich dioritic rocks have chemical compositions that are typically high in Fe, Ti and P (2). The Fe-rich dioritic rocks, in view of (a) their restricted occurrence at or near the margins of the massifs, (b) the systematic increase in mafic silicates and oxides from coarse core zone anorthosite to finer grained border zone (3), (c) older crystallization ages of dioritic rocks than the core anorthosite and d) due to absence of negative Eu-anomalies, in the dioritic rocks are considered as products of Soret effect (diffusion of Fe, Ti, Mg and Ca towards cold margins of deep-seated magmatic intrusion). The cold margins of magma got enriched in Fe, Ti,P,Mg on Ca due to Soret diffusion while the core portion got depleted in these same elements. The Fe-Ti oxide, deposits which occur as conformable layers within the Fe-rich gabbroic or dioritic rocks are considered as cumulates from the Fe-Ti rich liquids formed at or near the cold margins of massif by Soret diffusion of Fe-Ti (reminiscent of liquid immiscibility) and the massive cross-cutting ore bodies in the host anorthosite are due to collision, coalescence and settling of droplets of high density Fe-Ti oxide liquid from the Fe-Ti rich dioritic magma formed due to Soret diffusion as the roof of the magmatic intrusion .

The domical massifs have been unroofed exposing the Fe-Ti rich dioritic rocks at the margins of the massifs and the massive, cross-cutting ore bodies in the host anorthosite massif. This model explains the paucity or absence of apatite in the massive ore bodies and its abundance in the nelsonites and derives support from the fact that immiscibilemagnetite-apatite melts were not formed in the case of such intrusions such as the Skaergaard and Bushveld where there has been extreme iron enrichment during differentitaion and also explains why the important magmatic ilmenite (one of the earliest constituents of magma to crystallize) deposits, as a rule, occur in rocks rich in OPX rather than in olivine.

References:

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