

The Chromite Deposit of the Ipueira-Medrado Sill, São Francisco Craton, Bahia State, Brazil

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Abstract

The Ipueira-Medrado mafic-ultramafic sill hosts the largest chromite deposit in Brazil. The sill is a 7-km-long and 300-m-thick elongated body consisting mainly of interlayered dunite and harzburgite but also containing minor mafic rocks. The most distinctive feature of the Ipueira-Medrado sill is a continuous, 5- to 8-m-thick massive chromitite layer that is currently being mined. The anomalous thickness of this chromitite layer provides important constraints on current genetic models for the origin of massive chromitites.

The sill is divided into three zones: Marginal, Ultramafic, and Mafic. The Marginal zone (5–20 m thick) consists of sheared gabbro and orthopyroxene-rich harzburgite. The Ultramafic zone (up to 250 m thick) is subdivided into the Lower Ultramafic unit, the Main Chromitite layer, and the Upper Ultramafic unit. The Lower Ultramafic unit consists of dunite with minor harzburgite and chain-textured chromitite, the Main Chromitite layer is composed of chain-textured and massive chromitites, and the Upper Ultramafic unit consists mainly of harzburgite but also minor chain-textured chromitite and dunite. Pyroxene abundance increases toward the top in this zone and grades to an orthopyroxenite at the top. The presence of magmatic intercumulus amphibole is significant (up to 20 vol %) in this unit. The Mafic zone (up to 40 m thick) consists of leuconorites to melanorites that are partially metamorphosed under amphibolite facies conditions.

The variation of olivine and orthopyroxene compositions throughout the sill layers reveals two intervals of distinct magmatic evolution. The interval located below the Main Chromitite layer is characterized by gradual upward evolution of mineral compositions toward more Mg-rich compositions (Fo₉₃ and En₉₄). The interval located above the Main Chromitite layer is characterized by rapid evolution toward more Fe-rich compositions (Fo₈₅ and En₈₄) with increasing stratigraphic height. The interval below the Main Chromitite layer suggests crystallization in a dynamic magma chamber undergoing frequent replenishment with primitive magma. The interval above the Main Chromitite layer suggests crystallization in a mainly closed, fractionating magma chamber.

Mass balance considerations suggest that an enormous amount of magma (>10,000 m thick) was associated with the formation of the Main Chromitite layer at the Ipueira-Medrado sill. Such a volume of magma is obviously not represented in the stratigraphy of the Ipueira-Medrado sill. Mineral chemistry data indicate that the composition of the resident magma was most primitive at the stratigraphic interval immediately below the Main Chromitite layer. We suggest that the sill acted as a conduit through which a large volume of magma flowed. Under these conditions, contamination of the parental magma with crustal material and fluids is a likely mechanism for explaining the origin of the chromitite. Abundant intercumulus amphibole in the Upper Ultramafic unit and high Fe³⁺ in chromites, intercumulus orthopyroxene in Main Chromitite layer chromitites, and Sm-Nd and Re-Os isotope data for silicate rocks and chromitites, respectively, indicate that the Ipueira-Medrado sill formed from magmas contaminated by crustal material. The host rocks of the Ipueira-Medrado sill consist mainly of high-grade gneiss and marbles that would have been appropriate source of fluids and SiO₂ and could have caused the increase in f_{O_2} .

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