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Iron-rich ultramafic pegmatite replacement bodies within the Upper Critical Zone, Rustenburg Layered Suite, Northam Platinum Mine, South Africa

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ABSTRACT

Discordant veins, pipes and occasionally subconcordant sheets of iron-rich ultramafic pegmatite disrupt the layered cumulate sequence of the Upper Critical Zone, Rustenburg Layered Suite, Bushveld Complex. These pegmatite bodies have been studied where they replace the Merensky Reef footwall at Northam Platinum Mine, situated in the Swartklip Facies of the western lobe of the Rustenburg Layered Suite. Composed chiefly of ferroaugite and fayalitic olivine, the pegmatites appear to be formed by the preferential replacement of plagioclase-rich cumulates within the layered sequence. Fe-Ti oxides, sulphide (pyrrhotite and chalcopyrite) and plagioclase also occur in variable quantities. Differentiation within the pegmatite is observed where it has spread laterally beneath the impervious Merensky chromitite layer, with the development of subparallel cm-scale layers of massive magnetitite, massive sulphide and sulphide pegmatite. While some Fe-rich mobile phase must have been responsible for the pegmatites, it is concluded that the pegmatite bulk composition does not represent the original liquid. Furthermore the mode of occurrence precludes the injection of a crystal mush. Rather it is argued, mainly on geochemical and isotopic grounds, that Fe-rich residual melts derived from the Upper Zone in the downward crosscutting gap areas migrated laterally and upwards into the adjacent Upper Critical Zone. Variable reaction with the layered cumulates produced the anastomosing pegmatite bodies.

Keywords: iron-rich ultramafic pegmatites, Upper Critical Zone, Rustenberg Layered Suite, Bushveld Complex, South Africa.

Introduction

The presence of iron-rich ultramafic pegmatite (IRUP) bodies developed throughout the Rustenburg Layered Suite (RLS) was probably established very early in the exploration history of this remarkable igneous complex. In fact, the first discovery of economic levels of platinum group elements (PGE) was a Mg-rich dunite pipe in the eastern lobe of the RLS (Wagner, 1929; Cawthorn, 1999). Subsequent discoveries of vast reserves of the PGE in more stratiform settings within the RLS, such as the Merensky Reef and UG2 chromitite, have relegated the importance of the IRUP as an important PGE resource. However, underground development in the many mines established throughout the RLS has lead to the recognition that IRUP bodies can cause disruption of the stratiform mineralization by replacement, physical displacement and redistribution of the PGE (Viljoen and Scoon, 1985; Viring and Cowell, 1999). Apart from this undesirable influence on mining, the extreme petrological nature of the IRUP raises obvious questions as to its genesis. This project describes some of the IRUP bodies that have been exposed during underground operations at the Northam Platinum Mine (Fig. 1).

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Geological setting

This report follows the local geological community in South Africa by referring to the layered