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A geochemical profile through the Uitkomst Complex on the farm Slaaihoek, with special reference to the platinum-group elements and Sm-Nd isotopes

by

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ABSTRACT

The Uitkomst Complex is a mineralized, layered basic to ultrabasic intrusion, hosted by sedimentary rocks of the lower part of the Transvaal Supergroup. It is situated on the farms Uitkomst 541JT and Slaaihoek 540JT, about 25 km north of Badplass and 50 km east of the eastern limb of the Bushveld Complex in the Mpumalanga province of South Africa. The intrusion plunges between 8 to 10° to the northwest with an established length of 12 km and a total thickness of 850 m. It is divided into seven lithological Units (from base to top), the Basal Gabbro (BGAB), Lower Harzburgite (LHZBG), Chromiferous Harzburgite (PCR), Main Harzburgite (MHZBG), Pyroxenite (PXT), Gabbronorite (GN) and Upper Gabbro units (UGAB).

A detailed petrographic and geochemical investigation of borehole core SH176, which provided a complete intersection of the Uitkomst Complex was carried out. The study shows that the Complex may have crystallized in a dynamic magma conduit setting. The whole rock geochemical trends indicate that there is a reversed fractionation in the basal portion of the Complex and a lack of fractionation in much of the MHZBG. Trace and REE variations show a decrease in concentration with height, contrary to what is expected of a progressively differentiating magma in a close system. Further, the platinum-group element concentration of the four basal units show no depletion with increasing height, suggesting that the individual units are not related to each other by means of *in situ* fractionation. Instead, a model whereby the individual units crystallized from distinct pulses of magma best explains the data.

By comparing Nd isotopes and ratios of highly incompatible trace elements like $[Th/La]_n$ and $[Sm/Ta]_n$ from the Uitkomst Complex and Bushveld Complex it is seen that the Uitkomst magmas are of a similar lineage as the B1 magma of the Bushveld Complex, supporting a genetic link between the two complexes. The upper portion of the Uitkomst Complex shows values more akin to B3 magmas indicating the possible presence of more than one type of magma.

Based on the available S isotope and trace element data, the sulphides of the Complex appear to have formed within the Complex, probably in response to contamination of the magma with dolomite. Entrainment of sulphides from depth is considered unlikely. The relatively low Cu/Ni ratios of the sulphides in the LHZBG, PCR and MHZBG (Cu/Ni 0.03 to 0.8) may be modeled by sulphide segregation from B1 magma and not from fractionation of sulphides that were later entrained in the streaming magma.

OPSOMMING

Die Uitkomstkompleks is 'n geminaliseerde, gelaagde basiese tot ultrabasiese liggaam wat intrusief is in die sedimentêre gesteentes van die onderste deel van die Transvaal Supergroep. Dit is geleë op die plase Uitkomst 541JT en Slaaihoek 540JT, sowat 25km noord van Badplaas en 50km oos van die oostelike lob van die Bosveldkompleks in die Mpumalanga provinsie van Suid-Afrika. Die intrusie duik tussen 8 en 10° na die noordweste en het 'n bekende lengte van 12km en 'n dikte van 850m. Dit word onderverdeel in sewe litologiese eenhede (van onder na bo), die Basale Gabbro (BGAB), Laer Harzburgiet (LHZBG), Chroomryke Harzburgiet (PCR), Hoof Harzburgiet (MHZBG), Pirokseniet (PXT), Gabbronriet (GN) en Boonste Gabbro (UGAB).

'n Gedetailleerde petrografiese en geochemiese ondersoek van gesteentekern uit boorgat SH176, wat 'n volledige interseksie van die Uitkomstkompleks verteenwoordig, toon aan dat die Kompleks moontlik gekristalliseer het in 'n dinamiese magmatoevoerkanal. Daar is omgekeerde fraksionering in die basale deel van die Kompleks en 'n afwesigheid van fraksionering in die MHZBG. Die konsentrasie van platinumgroepelemente in die basale vier eenhede toon geen verarming met toenemende hoogte wat aandui dat die individuele eenhede nie aan mekaar verwant is deur *in situ* fraksionering nie. Die data word egter beste verduidelik deur 'n model waarin die individuele eenhede gekristalliseer het vanuit aparte magmapulse.

Deur vergelyking van Nd isotope en verhoudings van onversoenbare spoorelemente soos $[Th/La]_n$ en $[Sm/Ta]_n$ in die Uitkomstkompleks en die Bosveldkompleks kan daar gesien word dat die Uitkomstmagmas dieselfde oorsprong het as die B1 magma van die

Bosveldkompleks, dit ondersteun 'n genetiese verwantskap tussen die twee komplekse. Die boonste deel van die Uitkomstkompleks toon waardes meer verwant aan die B3 magmas en dui op die moontlike teenwoordigheid van meer as een tipe magma.

Beskikbare S isotoop en spoorelement data dui daarop dat die sulfiedes van die Kompleks binne in die Kompleks gevorm het, waarskynlik as gevolg van kontaminasie van die magma met dolomiet. Vervoer van sulfiedes vanuit diepte word as onwaarskynlik beskou. Die relatiewe lae Cu/Ni verhoudings (0.03 tot 0.8) van die sulfiedes in die LHXBG, PCR en MHZBG dui daarop dat die sulfiedes fraksionering van monosulfied vaste oplossing ondergaan het gevolg deur fisiese skeiding van monosulfied vaste oplossing en gefraksioneerde sulfiedsmelt, met die laasgenoemde opgeneem deur magma wat deur die Kompleks gevloei het.