

**GEOLOGICAL CHARACTERISTICS OF IRON OXIDE-
COPPER-GOLD (IOCG) TYPE MINERALISATION IN THE
WESTERN BUSHVELD COMPLEX.**

By

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ABSTRACT

The occurrence of large, massive iron oxide deposits throughout the Bushveld Complex, South Africa, and its associated roof-rocks is well known. The style of mineralisation and the associated alteration exhibits many characteristics of iron oxide-copper-gold (IOCG) type deposits. The contained mineralisation is dominated by iron oxide and fluorite and is accompanied by a diverse polymetallic association, with anomalous fluorite, copper, gold, barite, uranium and LREE.

The Ruigtepoort orebody, located in the western Bushveld Complex, is such an example and is surrounded by some 20 smaller occurrences in the upper stratigraphic portions of the Bushveld Complex, all displaying strong structural control. These IOCG bodies occur as narrow veins, hydrothermal breccias, subhorizontal sheets, or as pipe-like intrusions usually utilising pre-existing structures. Set in red Nebo granite, the mineralised core consists of severely chloritised rock that is haloed by progressively less-altered granite. The alteration passes from the chlorite core to more hematite-phyllsilicate-dominated alteration, to sericite-illite-dominated alteration; followed by the relatively fresh country granite. These alteration haloes dissipate rapidly away from the body over only a few metres. Sodic-calcic alteration described in other IOCG is not locally observed. Extensive zones of barren feldspar-destructive alteration exist, including K-metasomatism, sericitisation and silicification. Multiple alteration episodes appear to have occurred, resulting in extensive overprinting and a very complex paragenesis.

The primary mineral assemblage consists of Fe-chlorite, fluorite, quartz, hematite, and specularite, with accessory pyrite and chalcopyrite. Multiple generations of hematite, quartz, fluorite and chlorite are also observed. At other localities, the assemblage is dominated by magnetite-actinolite-britholite. Significantly enriched concentrations of Au (2 g/t), Cu (0,45 wt%), Ba, Y and LREE are encountered in the small, mineralised core.

A fluid mixing model is proposed characterised by an initial highly-saline, sulphur-poor magmatic fluid which mixed with a lower temperature oxidised, surficial fluid. Structure was probably a significant factor in determining the initial distribution of hydrothermal centres and the overall morphology of the entire system. Subsequently, continuous brecciation, alteration, mineral precipitation and fault activity helped develop the hydrothermal centres into a complex array of variably mineralised, lenticular, pipe-like and irregularly shaped breccia bodies.

DECLARATION

This dissertation is my own unaided work, conducted under the supervision of Prof. Laurence J. Robb. It is being submitted for the degree of Masters of Science in Geology at the University of the Witwatersrand, and has not been previously submitted for any degree or examination at any other university.

John Paul Hunt

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- Sample #ID 11181. f) Hydrothermal granite breccia with hematite-magnetite-quartz vein fill. Granite clasts affected by sericite alteration; Sample #ID 11178.
- Plate 6.4.** a) Hematite-quartz-fluorite vein-fill of brecciated quartz blocks. b) Flat-lying manto-shaped orebody with pegmatite sill base. c) Sericite-epidote altered granite near mineralised aplitic dykes; Sample #ID 11015. d) Gossan of hematite quartz and minor sulphides; Sample #ID 11217. e) Brecciated vein quartz with hematite-quartz-fluorite-sulphide vein fill. f) Siderite-magnetite ore in breccia vein fill; Sample #ID 11216. g) Coarse molybdenite flakes in pegmatitic quartz.
- Plate 6.5.** a) Example of hematite-quartz pseudomorphed actinolite crystals with fluorite filling the residual vug. Fl=fluorite. b) Actinolite blades range in size from less than 1 cm to in excess of 10 cm. c) Actinolite rock in outcrop from the Ysterkop North prospect. d) Fresh ferroactinolite blades from Ysterkop North with pink britholite euhedral. In weathered examples the ferroactinolite may alter to lime-green nontrite and the britholite to goethite (Crocker *et al.*, 2001); Act=actinolite, Brith=britholite. Sample #ID 11091. e) Mega-breccia of sub-rounded and angular granite blocks set in dissociated ferroactinolite matrix, from Ysterkop North. f) Mega-breccia from Ysterkop North of granite blocks in ferroactinolite matrix. Field of view approximately 4 m.
- Plate 6.6.** a) Massive hematite with intermingled white adularia, from Blokspruit 157JQ. b) Black hematite veining in fine-grained granite episyenite, the granite taking a deep red to purplish hue; Sample #ID 11057. c) Hematite infilling pore-spaces of granite episyenite. Fe₂O₃ now accounts for 26 wt% of bulk rock; Sample #ID 11053.
- Plate 6.7.** a) Hydrothermal granite breccia with hematite-quartz fracture fill associated with several mineralised occurrences on Elandslaagte 154JQ; Sample #ID 11147. b) Siliceous host rock to hematite-REE mineralisation, possibly bastnaesite-bearing; from Elandslaagte 154JQ; Sample #ID 11150. c) Siliceous host rock with abundant purplish hematite and fine specularite; Sample #ID 11152. d) White, crystalline quartzitic xenolith found in association with centres of hydrothermal activity; Sample #ID 11146. e) Intensely sericite-epidote altered granite country host rock; Sample #ID 11145. f) Massive hematite-quartz veins; Sample #ID 11079.
- Plate 6.8.** a) Chlorite-altered granite from Doornfontein 155JQ; Sample #ID 11085. b) Breccia of gossanous hematite after amphibole and chalcedonic quartz; Sample #ID 11073. c) Intense kaolinitisation of granite country rocks in immediate vicinity to mineralisation; Sample #ID 11083. d) Hydrothermal breccia with fragments of hematite-quartz gossan and granitic rocks; Sample #ID 11203.