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THE SUDBURY STRUCTURE (ONTARIO, CANADA) AND VREDEFORT STRUCTURE (SOUTH AFRICA) - A COMPARISON

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Both the Sudbury Structure (SS) and the Witwatersrand Basin surrounding the Vredefort Structure (VS) host some of the most important base and precious metal deposits on earth.
The SS in central Ontario lies at the boundary of the Superior Province with the Southern Province of the Canadian Shield. It is approximately 20 by 60km in size and has been dated at 1.84 Ma (Krogh et al 1984). The Vredefort Structure (VS) is of approximately the same age (Nicolaysen et al. 1963). Its diameter from the outer limit of the collar to the southern margin of the core is roughly 100km. In both structures Precambrian igneous, sedimentary and volcanic rocks have been affected by the structure forming process, either meteorite impact or endogenic explosion, or as some VS workers propose, by high strain tectonics. Besides these general features there are some geological and geophysical characteristics that are strikingly similar in both structures. There are, however, some obvious differences.

Directly related to the structure forming processes are breccias in the "footwall rocks" of both structures. Pseudotachylite breccias occuring in both structures display great similarities. They occur up to 80km away from the Sudbury Igneous Complex (SIC). The largest breccia body in the SS is 11 km long and up to 400 m wide. In Vredefort they have been observed mainly in well-defined zones along the contact between outer Granite Gneiss and Inlandsee Leucogranofels, but in places do occur throughout the metasedimentary collar. The largest breccia body is in the granite basement and is about 1 km long and 50-100m wide. Chemical and physical characteristics of the pseudotachylites are similar in both structures. Footwall Breccias (Dressler, 1984) occur in Sudbury underlying the SIC. These are contact metamorphic breccias consisting of footwall rock fragments in a recrystallized matrix. Very strongly remobilized phases of this breccia resemble inclusion bearing phases of the Inlandsee Leucogranofels in VS (granite breccia, Stepto, 1979). Very peculiar, amoeboid quartz occurs in the Leucogranofels and the Footwall Breccia suggesting incipient melting.
Equivalents of the 2000m thick succession of fallback breccias of the Onaping Formation (OF) in SS are lacking in the VS. The Sudbury melt bodies (Muir and Peredery, 1984)
may have their equivalents in the Vredefort Bronzite Granophyre as proposed by French (1987). Others (Reimold et al., 1987) consider this rock to be of a tectonic origin. Both rock types are characterized by footwall rock inclusions in an

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igneous matrix characterized by features suggesting rapid cooling.

Both structures are characterized by overturned collar rocks, not evident everywhere around the SS. The VS is rimmed by an up- or overturned collar of sediments and volcanics of the Witwatersrand, Ventersdorp and Transvaal Supergroups. Drilling information proved that the strata of the Witwatersrand Supergroup in the south of the VS are lying horizontally.-

Shockmetamorphic features such as planar microdeformations in rock forming minerals and shatter cones are present in both structures in the footwall rocks and in the SS also in the breccias of the OF. In Sudbury shatter cones occur up to 17km away from the SIC. Nicolaysen and Reimold (1987) proposed that shatter cone-like fractures in Vredefort are caused by a jointing phenomenon and are potentially different from true shatter cones. Striated joints and cones occur up to 90km from the centre of the VS.

Both structures have large geophysical anomalies associated with them (Gupta et al., 1984; Antoine and Reimold, this vol.).In both structures the anomalies have been interpreted by these researchers as being caused by mafic-ultramafic complexes underlying the structures.

Future research in both structures is needed and will eventually help to come to a better understanding of the origin of several controversial structures and possibly will prove that more or less identical phenomena can be formed by more than one process.

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