INVESTIGATION OF THE GEOLOGY AND MINERALISATION IN THE VICINITY OF THE GIBRALTAR I DRILL HOLE, NORTH-WEST OF TARCOOLA, SOUTH AUSTRALIA.

Robert C Webb B Sc.

Thesis submitted as a partial fulfillment for the Honours Degree of Bachelor of Science

Department of Geology and Geophysics
The University of Adelaide
October 1992

NATIONAL GRID REFERENCE: SH 5737-III
(CARNDING 1:100 000 Map Sheet)

Supervisor: R A Both

ABSTRACT

The Gibraltar I drill site is located 38 km north-west of Tarcoola, South Australia, within the Middle Proterozoic Gawler Range igneous province. The drill core has sampled the Ealbara Rhyolite, a member of the Lower Gawler Range Volcanics. This unit in the vicinity of the drill hole may be subdivided into a number of variably welded rhyolitic ash flow tuffs and lavas, all showing similar degrees of deuteric alteration.

Tectonic implications of the host volcanic geochemistry are consistent with a tectonic model of emplacement proposed by Giles (1980, 1988).

Hydrothermal alteration and mineralisation is noted in outcrop in the vicinity of the drill hole, and in the drill core itself. A hematite bearing quartz breccia and chloritic microbreccia are present, along with areas of often intense silicification and sericitisation. The drill core mineralisation consists mainly of vein and disseminated pyrite, with minor chalcopyrite, sphalerite, galena, pyrrhotite and marcasite. Sericite and quartz comprise the major gangue minerals, with minor chlorite, fluorite and calcite present as accessory phases.

Sulfur isotope analyses performed on pyrite from the drill core reveal isotopic ratios consistent with a felsic igneous source for the sulfur. Such a source is most likely to be the rhyolite pile hosting the mineralisation.

Temperature estimates of the hydrothermal fluids responsible for the hematite-bearing quartz breccia and Gibraltar I mineralisation, on the basis of fluid inclusions and chlorite analyses, indicate a range of 190°C to 300°C, characteristic of an epithermal type hydrothermal system. Salinities obtained from the fluid inclusion analyses indicate low salt contents (< 2% wt NaCl equivalent).

Geochemical modelling of the hydrothermal system at 300°C suggests that much of the sulphide depostion occurred between pH's of 2.8 and 4.8, with log oxygen fugacities ranging from -36.5 to -33.0. These conditions are unsuitable for significant gold transport, due to the low solubilities of gold complexes present in such a fluid.

A convective, groundwater derived hydrothermal system is considered responsible for the mineralisation sampled by the drill core. In the presence of a heat source, superposition of a convective flow regime upon meteoric waters would occur. Continued cyclic flow at elevated temperatures would allow the fluids to become enriched in metals and sulphur, with deposition resulting from mixing with less evolved groundwaters. The heat source for this system was most likely a subvolcanic magma chamber associated with the extrusive rocks hosting the mineralisation.

CONTENTS