zone strikes just east of north, dips to the west, and lies to the north of the drill hole intersection. A quantitative interpretation, based on a representation of the electromagnetic eddy currents by a rectangular current filament, suggests also that the conductor has a northerly plunge. The plan location of the best fitting rectangular filament is drawn in Fig. 6: it agrees well with the known body of mineralisation.

The use of drill holes offers a third dimension. There are often difficulties in gaining access down-hole and in carrying out surveys, and there are particular challenges in interpretation. But these challenges need to be met, to get the most from that expensive exploration tool the drill hole.

THE GEOPHYSICS OF THE RED DOME GOLD MINE AND SURROUNDING AREAS

Steve Collins

The Red Dome deposit is within a Siluro-Devonian shallow marine sedimentary sequence approximately 250 km west of Cairns (Figs 1, 2). The sequence, known as the Chillagoe Formation consists of limestone, sandstone, cherts and mafic volcanics. Rock strata within this sequence are generally steeply dipping. Approximately one kilometre west of the deposit is the Palmerville Fault which separates the Chillagoe Formation from the Pre-Cambrian Dargalong Metamorphics. Approximately 20 km to the east, the sequence is unconformably overlain by the relatively flat lying Featherbed Volcanics. The whole region is extensively intruded by granitic and porphyritic rocks.

The deposit is hosted by a rhyolite porphyry intrusion, which takes the form of several vertical stocks. Primary gold mineralisation occurs predominantly within a magnetite garnet skarn adjacent to the intrusion, but may also occur in

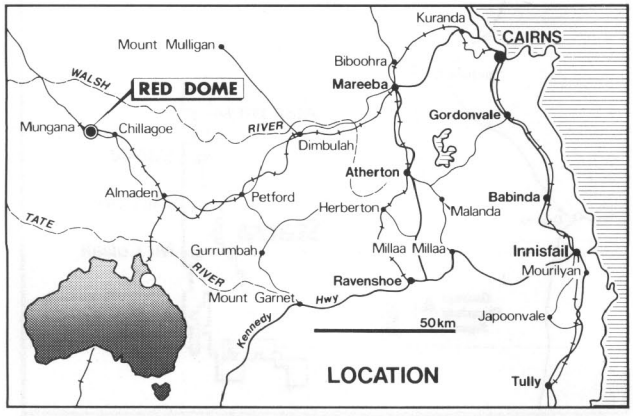

FIGURE 1
Location map.

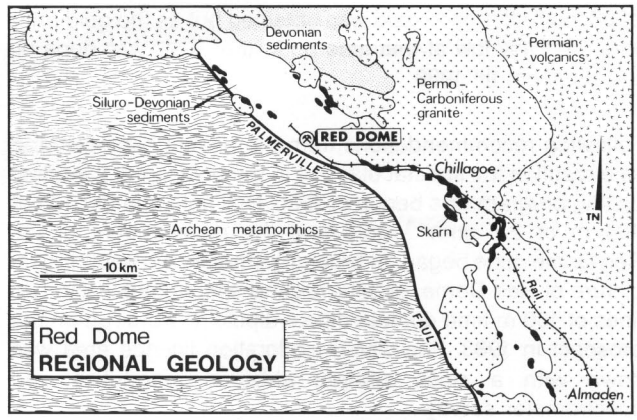

FIGURE 2
Regional geology.

sandstones and within the porphyry itself in areas of stock working. In the oxidised zone, which occurs in places to a depth of 150 m, the gold bearing skarn is weathered to a ferruginous breccia. Approximately 4 million tonnes of this material is currently being mined by Elders Resources.

The physical properties of the mineralised rocks vary over a wide range. The density of fresh gold bearing skarn can be greater than 4.0 $t.m^{-3}$ whereas its weathered equivalent has been found with densities of less than 1.2 $t.m^{-3}$. Densities of surrounding rocks range from 2.4 to 3.0 $t.m^{-3}$. Magnetite content and hence susceptibilities also vary widely. Susceptibility is not considered important as such, as induced magnetic effects in this area are dominated by remanence, generally by a factor of 4 or 5 to 1. Magnetite bearing rocks are the mineralised skarn and an unmineralised garnet skarn associated with andesitic volcanics. Sedimentary cherts may also contain significant magnetite. Fresh mineralised rocks and the porphyry intrusive contain several percent sulphides and as such are weakly I.P. responsive. Cherts may also be I.P. responsive, though the cause of this is not known. Resistivities of the porphyry intrusions are in the 1000 ohm-m range, surrounding rocks are of order of 100 ohm-m and the weathered breccias of order 10 ohm-m. Intrusive and altered rocks have a high potassium content and clay alteration associated with the mineralisation has elevated thorium. Uranium content is insignificant.

The exploration program by Amoco Minerals Aust Co. began in 1978 as a search for massive sulphide mineralisation similar to that found at the old Lady Jane and Girofla mines. These are extremely high grade silver, lead, zinc deposits and lie within a kilometre along strike from the current Red Dome mine. The genetic association of these with Red Dome, if any, remains a mystery. In the course of the exploration program, the Red Dome area was gridded and surveyed with magnetics, frequency domain I.P., self potential and Crone PEM techniques. None of these techniques produced recognisable anomalies over either the old massive sulphide mines or what is now the Red Dome mine. A significant IP, EM and SP anomaly, 300 m south west of the Girofla mine was incorrectly written off as 'black shale'. In 1978 Amoco's first Red Dome hole was drilled to test the ferruginous breccia at depth. The hole was unsuccessful in that it did not intersect sulphide mineralisation. An intersection

of 98 m of 1.8 gm.t^{-1} gold was obtained but as the gold price was relatively low at that time no further work was done on the prospect till 1980.

Following recommendations from the project geologist and as a result of the spectacular rise in the gold price, a modest drilling program was begun in 1980. Drill hole number 12 cut 404 m of 2.7 gm.t^{-1} gold and the development of the Red Dome mine began. In order to complete the geophysical picture of Red Dome, gravity, ground spectrometer and two lines of 100 m time domain dipole-dipole IP were run on the prospect in 1983. The whole exploration licence area was flown with a close spaced airborne magnetics and spectrometer survey.

The gravity survey produced a marked low over the Red Dome deposit. This is due to the very low density of the oxidised breccia material near surface. The technique is not considered to be useful in exploration for further deposits as any such breccia would be more cheaply and easily recognised by geological mapping than by a gravity survey.

A wide spaced government aeromagnetic survey of the area had shown large remanent magnetic negative anomalies throughout the region with a tantalising correlation between these and old workings. A ground magnetic survey of the Red Dome prospect in the early stages of base metal exploration indicated that the andesitic beds and their associated unmineralised garnet skarns were strongly negatively magnetised. Henceforth, all negative anomalies were written off as barren andesite. When the Red Dome deposit was extensively drilled, approximately five years after the original ground magnetometer survey, the question of why the magnetite rich high grade porphyry skarn seen at depth did not produce a surface magnetic anomaly was raised. Re-examination of the ground data showed a very clear deep anomaly caused by this material. It had not been previously recognised since, like the barren andesite skarn, it is negatively magnetised. Crude tests on core samples reveal a dominance of remanence over induced effects of between 2 and 10 times.

Two lines of 100 m dipole-dipole time domain IP were run over the deposit to reveal a deep chargeability anomaly and resistivity high associated with the porphyry intrusion. The pseudo-sections are complicated by near surface responses, particularly from cherts adjacent to the deposit. Early frequency domain IP surveys did not detect the body as the dipole spacing was too small for the depth of weathering. IP can be considered an effective if somewhat expensive detection tool for Red Dome style mineralisation.

As expected, ground spectrometer data revealed a strong potassium anomaly over the outcropping porphyry and a somewhat weaker anomaly over the surrounding alteration. What was not expected however were four thorium anomalies, three of which lay exactly over the three main areas of known mineralisation. The fourth, subsequently drilled during engineering testing, lies over a narrow weakly mineralised porphyry. The reason for these anomalies is unclear, but is probably elevated thorium content within zones of clay alteration surrounding the mineralisation.

Regional geophysical exploration work in the area now relies on airborne magnetic and spectrometer data and their ground equivalents for follow up. In some areas IP can be considered as a further follow up tool.

THE GEOPHYSICS OF THE STARRA GOLD/COPPER DEPOSITS

Steve Collins

The Starra gold-copper deposits are contained in a quartz-hematite-magnetite ironstone within the Upper Proterozoic Staveley Formation approximately 150 km south east of Mt. Isa. (Figs 1, 2). The mineralisation is contained in the western limb of a north plunging synform. It occurs over a strike length of appoximately 6 km in a number of zones which are named according to their distance in hundreds of metres from the regional grid origin. Geologic reserves to date are 6 million tonnes of 5 gm.t^{-1} gold and 2 percent copper.

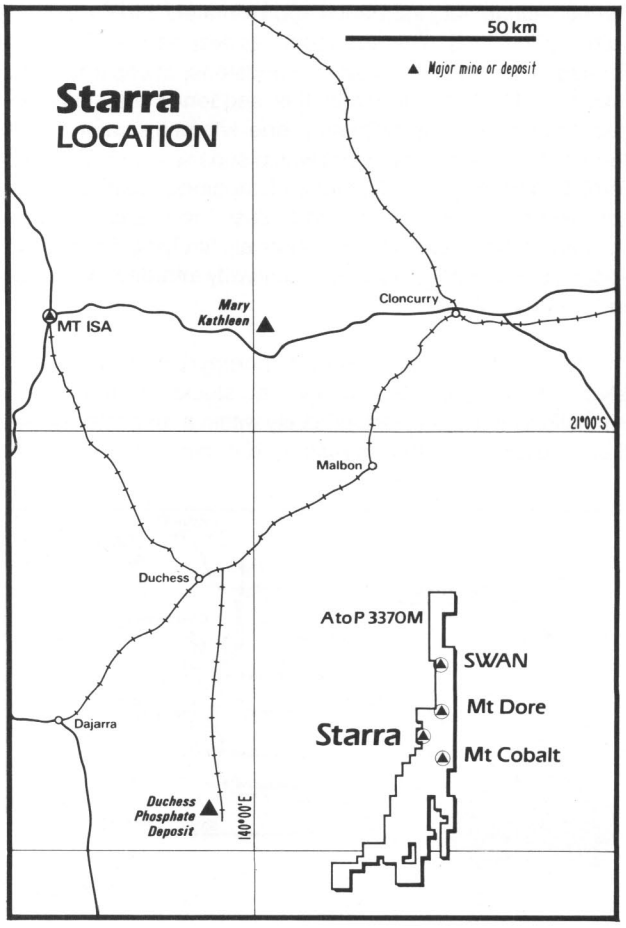

FIGURE 1
Starra location plan.