*Exploration Geophysics (1997) 28, 26-28*

# Compilation of Geophysical Signatures of South Australian Mineral Deposits: a Progress Report

**M.C. Dentith**
*Deptartment of Geology & Geophysics,*
*The University of Western Australia,*
*Nedlands, WA 6907.*
*Phone: (09) 380 2676, Fax (09) 380 1037.*

**T.N. Crabb**
*Mines & Energy South Australia,*
*PO Box 151,*
*Eastwood, SA 5063.*

## ABSTRACT

To take advantage of large quantities of new geophysical data and increased exploration interest due to the South Australian Exploration Initiative a compilation of the geophysical signatures of South Australian mineral deposits has been undertaken. This project has two stages which will be described in a two-volume publication. The first volume, scheduled for publication in 1996, summarises all publicly available data, and some proprietary data, on the geophysical signatures of the State's mineral deposits. Separate chapters describe deposits according to the dominant commodity. These include copper, iron, uranium, lead–zinc, and other commodities such as gold, nickel, talc and graphite. The total number of deposits discussed is 44.

The second volume, scheduled for publication in early 1997, is primarily concerned with newly acquired airborne geophysical data, from the South Australian Exploration Initiative and also Australian Geological Survey Organisation and commercial surveys. The majority of the data described will be aeromagnetic, but other data will be included as required and available. For each deposit, data from the surrounding few tens of kilometres will be presented and interpreted with emphasis on lithological and structural control of the deposit. Regional-scale interpretations will also be included, again emphasising controls on known mineralisation.

Keywords: Mineral exploration, geophysical signatures, South Australia

## INTRODUCTION

In 1993 the Key Centre for Strategic Mineral Deposits, Department of Geology and Geophysics, The University of Western Australia and the Australian Society of Exploration Geophysicists jointly published a book titled Geophysical Signatures of Western Australian Mineral Deposits (Dentith et al., 1993). That volume contains papers, mainly written by industry personnel, describing the geophysical responses of a wide range of mineral deposits in Western Australia. To build on the success of that volume and take advantage of the increased exploration interest in South Australia, Mines and Energy South Australia (MESA) and the Department of Geology and Geophysics at The University of Western Australia are producing an equivalent volume describing mineral deposits in South Australia.

## SOUTH AUSTRALIAN EXPLORATION INITIATIVE

The South Australian Exploration Initiative (SAEI) was launched by the South Australian Government in 1992 to stimulate exploration in the State. Around 75% of a total of approximately $18.5 million expenditure has been allocated to mineral exploration programs, which include airborne and ground geophysics, bedrock drilling and the production of geoscientific databases (Newton, 1996).

Airborne geophysics is an essential component of the SAEI due to a general dearth of outcrop in South Australia, although prospective rocks are known to be widespread in the subsurface. At the time of writing approximately one million kilometres of new data have been acquired covering over 400 000 square kilometres (~40%) of South Australia. The SAEI data have been supplemented by commercial surveys and surveys flown at equivalent specifications by the Australian Geological Survey Organisation (AGSO), and in conjunction with AGSO and the New South Wales Department of Mineral Resources as part of the Broken Hill Exploration Initiative. Criteria for area selection were availability of existing data; previous exploration history; and anticipated thickness of cover.

Attention was paid to the boundaries of previous commercial surveys such that data could be merged to provide information over as large an area as possible. Standard survey specifications were 80 m flight height and 400 m line spacing, reduced to 200 m in certain areas. Lines were flown either north–south or east–west parallel to the AMG. Radiometric and total magnetic intensity data are available as 'block areas' as a set of colour images at 1:250 000 scale and as contour maps at 1:100 000 and 1:250 000 scale. Micro-levelled digital data are available in line or gridded format.

Although the SAEI has now entered its closing stages, the resulting database will continue to be a valuable resource for mineral explorers for the foreseeable future. The vast increase in the availability of modern geophysical data from South Australia provides an opportunity to not only understand the geology, tectonic evolution and prospectivity of the State but also to study the structural and stratigraphic setting of known mineral deposits. South Australia contains many small deposits, particularly of copper, as well as the world-class copper–uranium–gold deposit at Olympic Dam. The majority of these deposits were discovered prior to the widespread use of geophysics and studies of the local to regional-scale controls on their location have not previously been possible, given the extent of outcrop. The SAEI data now allows such a study to be undertaken.

## GEOPHYSICAL SIGNATURES OF SOUTH AUSTRALIAN MINERAL DEPOSITS

The purpose of the project on geophysical signatures of South Australian mineral deposits is to report, synthesise and provide a source of reference for mineral explorers in South Australia. The initial aim of the project is to produce

# *Now at: Scintrex, 222 Snidercroft Road, Concord, Ontario, Canada L4K 1B5. Phone 905 669 2280, Fax 905 669 9334*

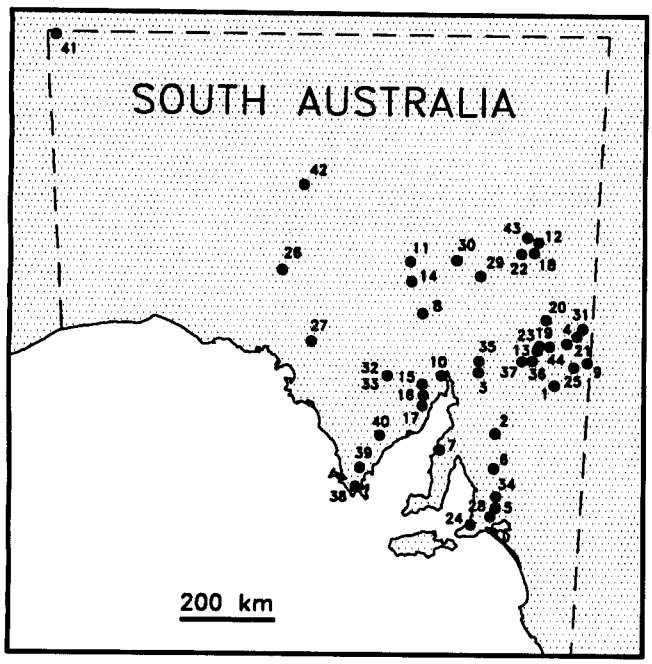


Figure 1. Map showing locations of mineral deposits described in volume 1 of Geophysical Signatures of South Australian Mineral Deposits. 1 - Anabama Hill, 2 - Burra, 3 - Copper Claim, 4 - Dome Rock, 5 - Kanmantoo, 6 - Kapunda, 7 - Moonta–Wallaroo area, 8 - Mount Gunson, 9 - Mutooroo, 10 - Myall Creek, 11 - Olympic Dam, 12 - Parabarana, 13 - Prince Alfred, 14 - Acropolis, 15 - Iron Princess, 16 - Iron Prince, 17 - Iron Duke, 18 - Beverley, 19 - Crocker Well, 20 - Goulds Dam, 21 - Honeymoon, 22 - Mount Painter area, 23 - Mount Victoria, 24 - Myponga, 25 - Radium Hill, 26 - Warrior, 27 - Yarranna, 28 - Angas, 29 - Beltana, 30 - Ediacara, 31 - Hunters Dam, 32 - Minninnie Dam, 33 - Telephone Dam, 34 - Mount Torrens, 35 - Yanyarrie, 36 - Teetulpa area, 37 - Waukaringa area, 38 - Uley, 39 - Koppio, 40 - Carpa, 41 - Claude Hills, 42 - Coober Pedy area, 43 - Mount Fitton, 44 - Ethiudna.

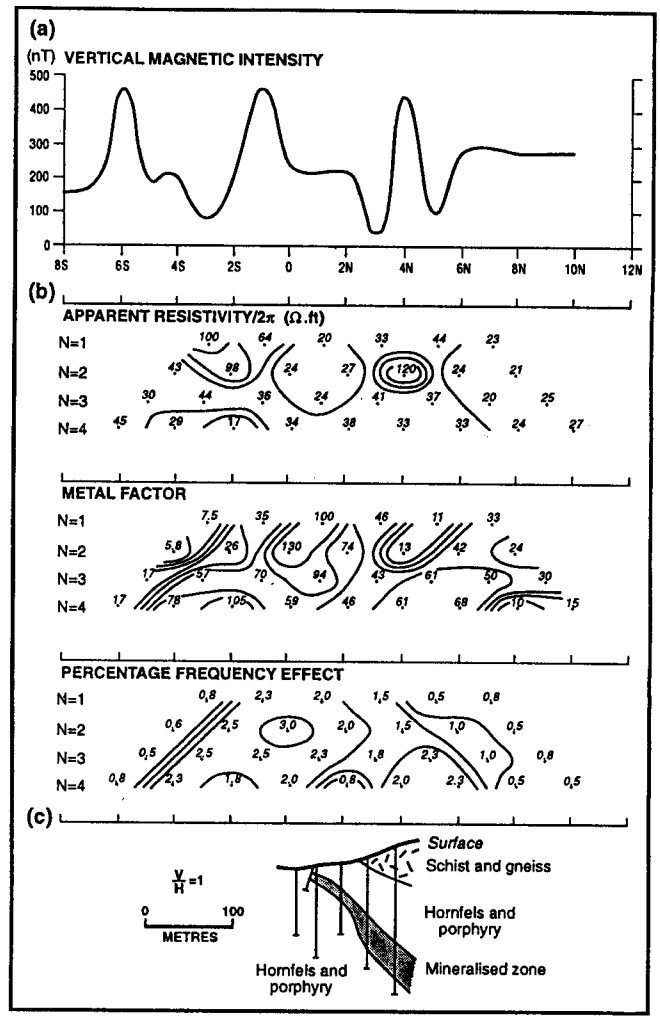


Figure 2. Summary geophysical and geological data from the Parabarana copper deposit, South Australia. a) magnetic data, b) induced polarisation pseudosections, c) geology from drilling.

two MESA report books. The first of the two is based predominantly on open-file data held by MESA in its Document Storage Centre, but also some confidential data generously made available by various companies, and also data described in various unpublished reports and theses. The second volume, planned for publication in 1997, will describe mainly airborne data collected as part of the SAEI. Data from the vicinity of the deposits described in the first volume, plus additional deposits, will be imaged to highlight the structural and stratigraphic setting of the mineralisation. Thus, the second volume will contain a catalogue of images over known mineral occurrences in South Australia derived from the new airborne geophysical datasets.

Figure 1 shows the location of mineral deposits included in volume 1 of Geophysical Signatures of South Australian Mineral Deposits. A total of 44 deposits, including all the major deposits in the State, are described, with an emphasis being placed on copper deposits.

In selecting which deposits to include a number of criteria were adopted. The first was availability and quality of data. Many of South Australia's most famous mineral deposits, for example the copper deposits at Kapunda and Burra, were discovered last century and obviously geophysics played no role in the discovery. However, geophysical surveys, particularly IP, were carried out in many of these areas in the 1970s. These surveys were quite successful at detecting the mineralisation but were hindered by the disturbance of the site due to earlier mining operations, and the fact that the deposits are located in agricultural areas — and hence fences, pipes, etc. are common. The problem of site disturbance is particularly severe in the case of the basement-hosted uranium deposits, such as Radium Hill, where many of the radiometric surveys post-dated the first mining operations. Consequently, many of the well known mining areas in South Australia have yielded few useful data, and hence attention has been paid to other less well-known deposits.

A second criterion in selecting deposits was to ensure that as wide a range of deposit styles as possible was covered. This has led to significant discussions of some minor prospects, but size was not considered an important selection characteristic. Also considered of importance in the selection of deposits was the requirement to cover a wide geographic area and age range. However, it is clear from Figure 1 that the location of known deposits is heavily biased towards the areas with better outcrop in the east of the State.

Having identified a particular deposit for inclusion, all available geophysical and geological data were reviewed. Depending on available data, a geological map and representative cross-section of the deposit are reproduced. If possible, these coincide with the location of the geophysical surveys. Multiple geophysical datasets from the same area/section are then combined into a series of figures which summarise the geophysical response of the mineralisation as succinctly as possible. An example of this form of presentation is given in Figure 2, for the Parabarana copper deposit (Figure 1).

The type of airborne geophysical data presented in volume 2 of the series is chosen depending on the deposit

type. For structurally controlled deposits in sedimentary strata, for example the copper deposits of the Adelaide Geosyncline (such as Kapunda, 6 in Figure 1), total magnetic intensity and total count radiometric data are found to be useful. However, in crystalline terrains, such as the gold deposits in the Precambrian rocks in the northwest of South Australia, only magnetic data are used. Other data, such as gravity, are only utilised when the coverage is sufficiently good and when large-scale structures are expected to be influencing the location of mineralisation — for example, basement highs close to Mississippi Valley-type base metal deposits (such as Ediacara, 30 in Figure 1). Overall, the aim is to identify the semi-regional scale structural and stratigraphic controls on mineralisation with the aim of providing exploration criteria for the discovery of further deposits.

## DISCUSSION

Inevitably any publication on the geophysical signatures of South Australian mineral deposits will be compared with the earlier volume with the equivalent title describing the geophysical responses of Western Australian mineral deposits. However, there are significant differences in the nature of the two projects. The Western Australian volume consists of a series of case-study papers written by industry, government and academic authors, plus three longer overview papers. The South Australian volumes are the work of a small team based at MESA, and utilise mainly public-domain data. The different approach was used partly because of temporal constraints on the South Australia project. Also, the likelihood of obtaining a good selection of papers by other authors was considered slight because of the lesser number of mineral deposits in the State, and the fact that much of the geophysical exploration dates from the 1960s and 1970s. Thus, although the two volumes are complementary, they do not form part of a series.

The compilation of geophysical data from South Australia shows that, overall, such methods have been relatively successful. The best known example is the discovery of Olympic Dam. However, most of the significant copper and base metal occurrences have some form of geophysical expression, particularly in IP and EM data. Since the majority of these data were collected in the 1970s, it is to be expected that surveys with more advanced equipment, directed at targets selected from interpretation of the SAEI data, would be at least as useful.

## ACKNOWLEDGMENTS

Mike Dentith acknowledges financial support from Mines and Energy South Australia, and study leave from The University of Western Australia to undertake the work described here. Figure 2 was drafted by the Publications Section at MESA.

## REFERENCES

Dentith, M.C., Frankcombe, K.F., Ho, S.E., Shepherd, J.M., Groves, D.I. and Trench, A., 1993, eds, Geophysical signatures of Western Australia mineral deposits. Geology and Geophysics Department (Key Centre) and UWA Extension, The University of Western Australia, Publication 26, Australian Society of Exploration Geophysicists Special Publication 7, 454 pp.

Newton, A.W., 1996, Mineral exploration and development in South Australia. South Australia. Department of Mines and Energy. Report Book, 96/1.