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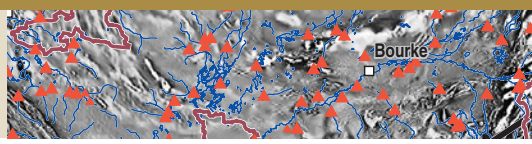
Regional geochemical study paves way for national survey

Geochemistry of near-surface regolith points to new resources



Megan Lech and Patrice de Caritat

The Thomson Regional Geochemical Survey covered an area of approximately 155 000 square kilometres in northwestern New South Wales (figure 1), encompassing parts of the Thomson Orogen and the adjacent Lachlan and Delamerian Orogens (Greenfield et al 2006a).

The project aimed to boost greenfield mineral exploration in the region by providing an internally consistent, background geochemical dataset for the southern Thomson Orogen region. It also aimed to refine sampling protocols developed in other regions to ensure their suitability to a range of environments across Australia.

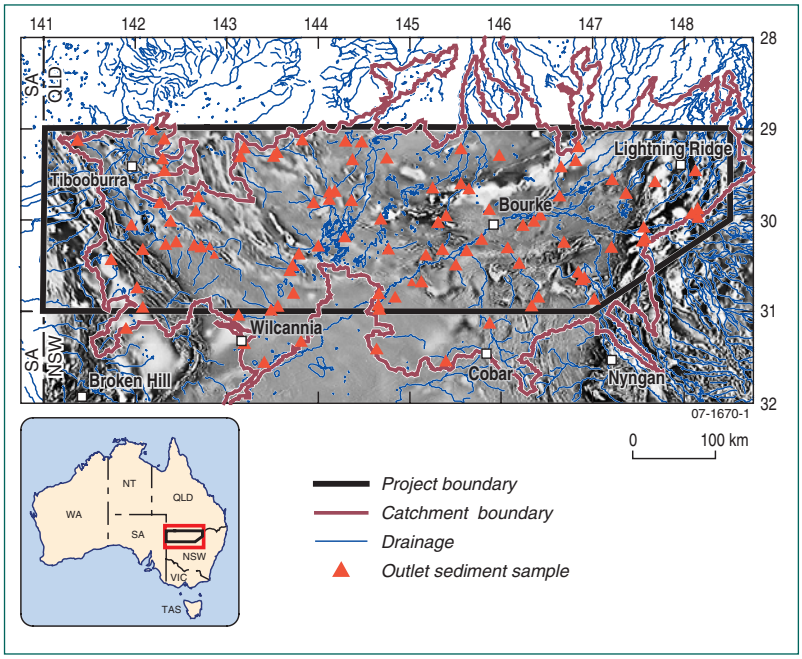


Figure 1. Sample locations over image of the first vertical derivative of the total magnetic intensity (courtesy of NSW Department of Primary Industries).

The region is covered by substantial transported regolith, including sediments from the Cainozoic Lake Eyre, Bulloo–Bancannia and Murray–Darling river basins and Cainozoic sand dunes and sand plains. Outcropping crystalline basement includes various mineral occurrences in the Broken Hill (lead, zinc, tin), Tibooburra (gold) and Cobar (lead, copper, gold) regions.

Interest in conducting a geochemical survey in the Thomson region arose from a similar survey in the Riverina region of New South Wales and Victoria (Caritat et al 2004), and the preliminary interpretations that resulted (Caritat et al 2005).

The Riverina survey identified geochemical patterns in the near-surface regolith that relate to geological and mineralisation features below the cover. These included elevated regolith gold concentrations in catchments containing known gold deposits or occurrences, dispersion trains of arsenic and antimony from the Victorian goldfields, and anomalous silver, lead and zinc in the eastern part of the study area which borders the base metal-rich Lachlan Fold Belt.

The Riverina and Thomson results show how regional geochemical surveys can provide fundamental datasets for mineral exploration and resource potential evaluation, environmental monitoring and policy development, and geomedical studies into the health of humans, animals and plants.

The Thomson Regional Geochemical Survey was a collaborative project between Geoscience Australia, the Cooperative Research Centre for Landscape Environments and Mineral Exploration (CRC LEME), and the NSW Department of Primary Industries (Greenfield et al 2006b).

Floodplain sediments provide evidence

The main sampling medium targeted for the survey was overbank sediments in floodplains. This is more likely than other media to represent an average composition of entire catchments, enabling low-cost sampling of large areas (Ottesen et al 1989, Bølviken et al 2004). Target sample sites were selected by conducting hydrological analysis to determine the lowest point in each catchment. Samples were collected at background locations, away from areas of obvious disturbance or contamination.

At each site, two intervals approximately 10 centimetres thick were sampled: one at 0 to 10 centimetres below the root layer, if present (top outlet sediment, TOS), and another usually at a depth of 60 to 90 centimetres (bottom outlet sediment, BOS). A total of 99 catchment outlet sites were sampled over the area, giving an average sample density of 1 per 1540 square kilometres. To date, geochemical results are available for the first 76 sites.

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Samples were dried and sieved at <75 µm and <180 µm fractions before geochemical analysis. The concentrations of over 60 major and trace elements were determined by X-ray fluorescence and inductively coupled plasma – mass spectrometry (ICPMS). Sample preparation for ICPMS involved 4-acid 'near-total' digestion for multi-element analysis and multi-acid digestion for selenium analysis. Ion selective electrode analysis was undertaken to measure fluorine, and graphite furnace – atomic adsorption spectrometry for gold.

High concentrations at several sites

Figures 2a to c and 3 provide information on the concentrations of copper, lead and antimony with their corresponding geochemical distributions.

A copper anomaly is present in the BOS <75 µm and <180 µm fractions (32 milligrams per kilogram (mg/kg) and 24 mg/kg, respectively) near the Barrier Ranges north of Broken Hill and 50 kilometres southeast of Brewarrina (29 mg/kg and 27 mg/kg). Seventy kilometres southeast of Tibooburra there is a sample with a notably high copper concentration (25 mg/kg) in the <180 µm fraction. Higher concentrations of copper in the central west are only a few kilometres away from a recent exploration company drill hole that intersected bedded pyrite mineralisation (figure 2a).

Elevated lead concentrations (21.7 mg/kg) are visible in the southeast, presumably reflecting proximity to the Barrier Ranges, and northeast of Cobar near outcrop of the Lachlan Fold Belt. Both regions have known lead mineral occurrences. Elevated lead values (19.48 mg/kg and 19.22 mg/kg in the <180 µm fraction) also occur in the central west, coincident with elevated copper values (figure 2b).

Antimony shows similar geochemical patterns to lead and copper. Antimony is notably higher northeast of Cobar and in the central west (0.70 mg/kg) in the <180 µm fraction. Values of 0.86 mg/kg and 0.79 mg/kg for the <180 µm fraction were recorded in samples collected 40 kilometres north of Cobar on Yanda Creek (figure 2c).

Anomalous concentrations of lead, copper and antimony mostly occur proximal to

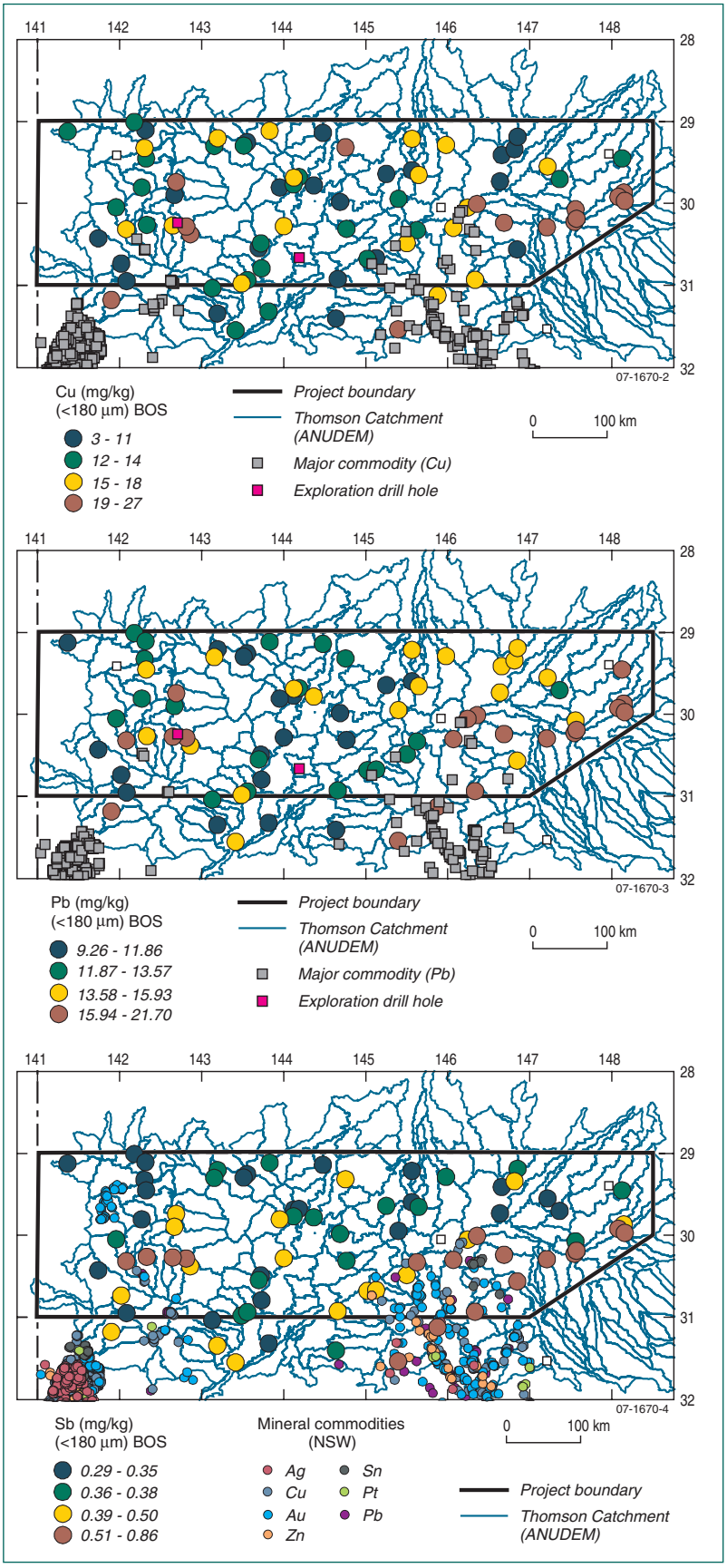

Figure 2. **(a)** Geochemical map of copper concentrations in the BOS <180 µm fraction with known copper occurrences; **(b)** Geochemical map of lead concentrations in the BOS <180 µm fraction with known lead occurrences; **(c)** Geochemical map of antimony concentrations in the BOS <180 µm fraction with known mineral occurrences

outcropping crystalline basement. Three main areas have been identified:

- southwest region, corresponding to the Curnamona Craton which hosts the Broken Hill orebody
- central to southwest region at the junction of the Koonenberry, Thomson and Lachlan crustal elements
- eastern and southern region, where the east and west Lachlan crustal elements adjoin beneath the Cobar Basin.

Lessons for exploration

Lower element concentrations generally coincide with areas of thicker Great Australian Super Basin cover. Thresholds in this area may need to be lowered to correctly assess the prospectivity of these terrains.

Generally, catchments with known mineral occurrences relating to lead, copper or antimony have anomalous concentrations of that element in the outlet sample. Dispersion of elements appears to be at the catchment scale.

Several anomalous concentrations occur away from known mineralisation and warrant further investigation. These include results from recent company drilling north of the Koonenberry Belt and northeast of Cobar.

The success of the Thomson and other pilot geochemical surveys led to the recent announcement of the continent-wide National Geochemical

Survey of Australia project (Baldwin 2007). That project is part of the Australian Government's Onshore Energy Security Initiative (Johnson 2006) and will gather geochemical data that will principally be used to support exploration for Australia's energy-related resources.

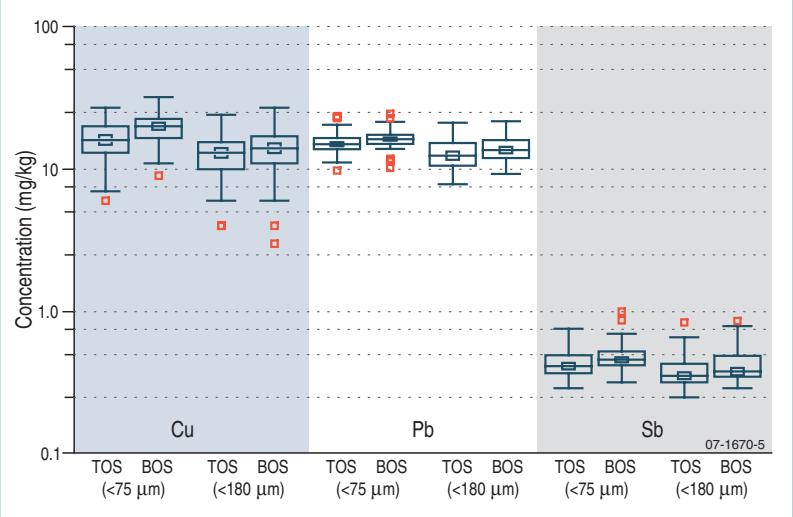

Figure 3. Boxplots of copper, lead and antimony concentrations in the TOS and BOS <75 and <180 µm fractions.

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References

Baldwin B (Parliamentary Secretary for Industry, Tourism and Resources). 2007. Zeroing in on Australia's onshore energy and minerals. Media release, 2 March 2007, Department of Industry Tourism and Resources. Available at: minister.industry.gov.au/index.cfm?event = object.showContent&objectID = 0F26ADF9-C2A0–4C89-FC1574CD3883BEAA

Bølviken B, Bogen J, Jartun M, Langedal M, Ottesen RT & Volden T. 2004. Overbank sediments: a natural bed blending sampling medium for large-scale geochemical mapping. Chemometrics and Intelligent Laboratory Systems 74:183–199.

Caritat P de, Jaireth S, Lech M & Pyke J. 2004. Regional geochemical surveys: Riverina Pilot project—methodology and preliminary results. Cooperative Research Centre for Landscape Environments and Mineral Exploration Open File Report 160. Available at: www.crcleme.org.au/Pubs/OFR160/CRCLEME_OFR160.pdf

Caritat P de, Lech M, Jaireth S, Pyke J & Lambert I. 2005. Riverina geochemical survey—A National First. *AusGeo News 78*. Available at: www.ga.gov.au/image_cache/GA6632.pdf

Greenfield J, Reid W, Gilmore P, Caritat de P, Lech M, Hill S, Hulme K, Watkins J & Worrall L. 2006a. The Thomson Orogen Project—a work in progress. In: Fitzpatrick RW & Shand P (eds), Regolith 2006—Consolidation and dispersion of ideas. Proceedings of the CRC LEME Regolith Symposium, Hahndorf, South Australia, 6–9 November 2006. Available at: crcleme.org.au/Pubs/Monographs/regolith2006/Greenfield_J.pdf

Greenfield J, Caritat de P, Hill P & Reid W. 2006b. The NSW Thomson Orogen Project: new frontiers in exploration, In: NSW DPI Mines and Wines Conference, Cessnock, 25–26 May 2006, Cessnock. Available at: www.smedg.org.au/Greeab.pdf

Johnson J. 2006. Onshore Energy Security Program underway. Web page: www.ga.gov.au/ausgeonews/ausgeonews200612/onshore.jsp (accessed 29 February 2007).

Ottesen RT, Bogen J, Bølviken B & Volden T. 1989. Overbank sediment: a representative sample medium for regional geochemical sampling. Journal of Geochemical Exploration 32:257–277.

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