

# A laterite geochemical map of the western Yilgarn Craton

by

P. Morris and M. Cornelius<sup>1</sup>

The majority of datasets used for regional-scale mineral exploration are remotely sensed, such as airborne geophysics and Landsat TM. Geochemical surveys using widely spaced samples have been successful in identifying unanticipated geochemical features in China, Finland and Fennoscandia, reflecting both anthropogenic and mineralization signatures. In Western Australia, regional geochemical datasets have been generated by both CSIRO (Smith et al., 1992; Geological Survey of Western Australia, 1998) and GSWA (Morris and Verren, 2001), with the success of these data in outlining regional geochemical trends related to potential mineralization discussed by Smith et al. (1992), Cornelius et al. (2001), and Morris and Verren (2001). These studies have shown that multi-element analytical data for various regolith sample types can be used to directly identify either mineralization, alteration related to mineralization, or pathfinder element associations indicative of mineralization. However, there are few datasets that combine contiguous and extensive coverage with a unique sample medium and a comprehensive analyte suite. The laterite geochemistry dataset generated for the western part of the Yilgarn Craton addresses these issues, and provides baseline geochemical data that can be used to explore for a variety of commodities.

Ferruginous duricrust (loosely referred to as 'laterite'), which is widely distributed throughout the Yilgarn Craton, in large part results from the weathering in situ of the underlying bedrock. In addition to its widespread availability, two other factors make this an attractive sampling medium for regional geochemical surveys. Firstly, the ferruginization process responsible for duricrust formation can also involve the sequestration of both ore and pathfinder elements from bedrock-hosted mineralization. Secondly, as much of this laterite consists of pea-shaped gravel (pisoliths), mineralization haloes can be enhanced by the mechanical dispersion of pisolitic laterite. The potential for laterite as a sampling medium in regional geochemical surveys has been realized by studies carried out at CSIRO (Smith et al., 1987; 1989) that showed that laterite chemistry can vector towards

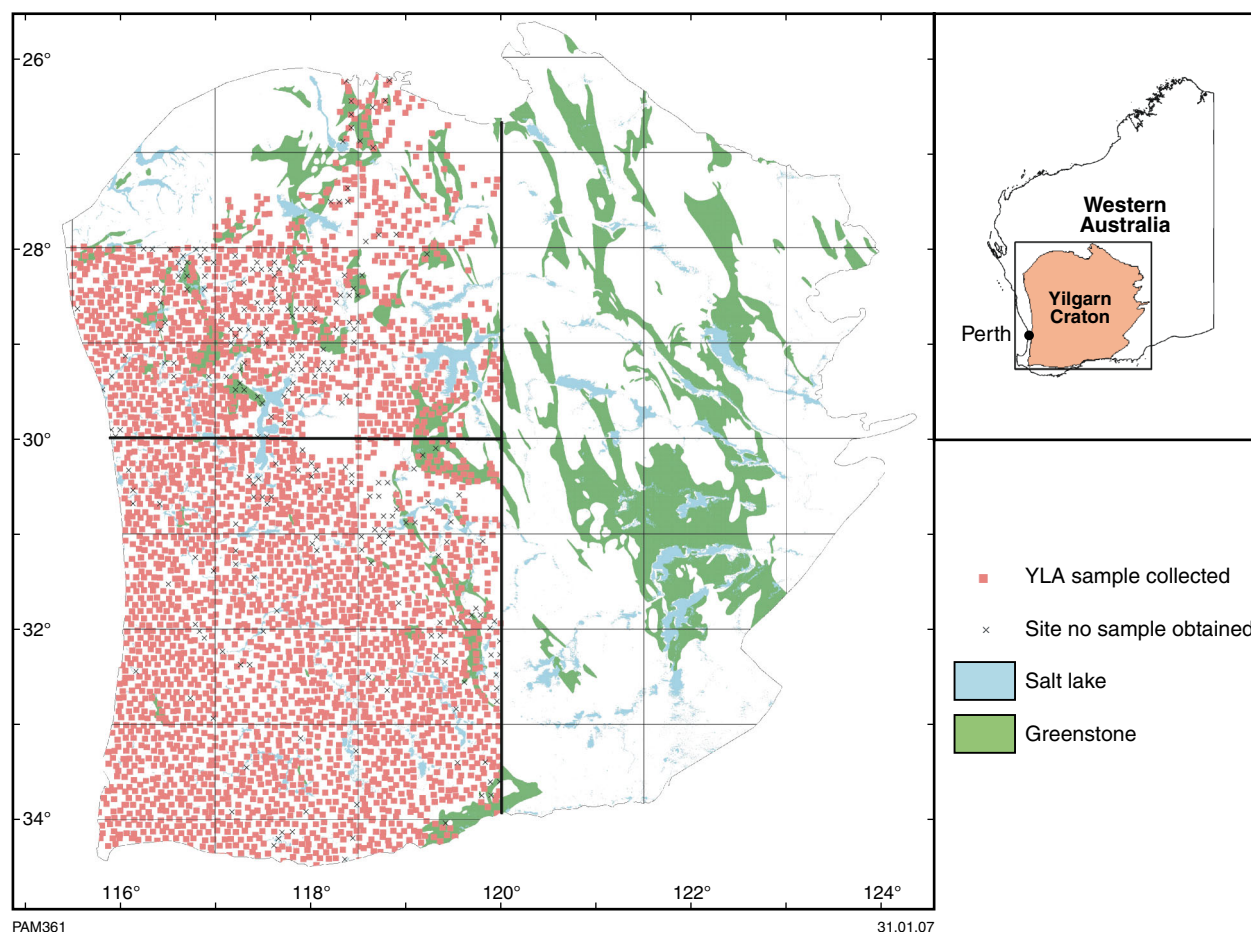
known rare-metal pegmatite and gold deposits on the Yilgarn Craton.

The laterite geochemical map of the western Yilgarn Craton comprises more than 3000 analyses of laterite sampled on a nominal 9-km triangular grid (i.e. a sample density of one sample per 70 km<sup>2</sup>), with each sample analysed for a minimum 53 elements. Where possible, samples from pre-existing laterite geochemical programs were reanalysed (Smith et al., 1992; Geological Survey of Western Australia, 1998). The preferred sampling medium was pisolitic laterite (84% of samples), with smaller proportions of lag derived from pisolitic gravel, and fragments of duricrust. Major results from the program include elevated Au abundances beyond areas of known greenstone-hosted gold mineralization (suggesting a greater extent of greenstones), more extensive areas of Au and base metal mineralization shown by chalcophile element abundances, and the possibility of previously unknown greenstone remnants within granitic terrains. A regional trend in Hg abundances in laterite may be related to craton-scale structures rather than particular lithologies. The decrease in Al<sub>2</sub>O<sub>3</sub> abundance from west to east coincides with a decrease in rainfall inland, suggesting some climatic control on aspects of regolith geochemistry.

## References

- CORNELIUS, M., SMITH, R. E., and COX, A., 2001, Laterite geochemistry for regional exploration surveys — a review and sampling strategies: *Geochemistry: Exploration, Environment, Analysis*, v. 1, p. 211–220.
- CORNELIUS, M., MORRIS, P. A., and CORNELIUS, A. J., 2006, Laterite geochemical database for the southwest Yilgarn Craton, Western Australia: CRC LEME, Open File Report 201 (CSIRO Report P2006/75), 27p.
- GEOLOGICAL SURVEY OF WESTERN AUSTRALIA, 1998, Laterite geochemistry of the Yilgarn Craton and Albany–Fraser Orogen: digital data from CSIRO-AGE: Western Australia Geological Survey, Record 1998/8, 13p.
- MORRIS, P. A., and VERREN, A. L., 2001, Geochemical mapping of the Byro 1:250 000 sheet: Western Australia Geological Survey, 1:250 000 Regolith Geochemistry Series Explanatory Notes, 53p.

<sup>1</sup> CRC LEME, c/- CSIRO Exploration and Mining, PO Box 1130, Bentley, W.A. 6102.



**Figure 1. Distribution of samples analysed for the Yilgarn laterite map. Horizontal black line separates approximately 2000 samples from the first phase of the program (south; Cornelius et al., 2006) from approximately 1000 samples from the second phase of the program (north)**

SMITH, R. E., ANAND, R. R., CHURCHWARD, H. M., ROBERSTON, I. D. M., GRUNSKY, E. C., GRAY, D. J., WILDMAN, J. E., and PERDRIX, J. L., 1992, Laterite geochemistry for detecting concealed mineral deposits, Yilgarn Craton, Western Australia — Summary Report: CSIRO Division of Exploration Geoscience, Restricted Report 236R (Reissued as Open File Report 50, CEC LEME, Perth 1998).

SMITH, R. E., BIRRELL, R. D., and BRIGDEN, J. F., 1989, The implications to exploration of chalcophile corridors in the Archaean Yilgarn Block, Western Australia, as revealed by laterite geochemistry: *Journal of Geochemical Exploration*, v. 32, p. 169–184.

SMITH, R. E., PERDRIX, J. L., and DAVIS, J. M., 1987, Dispersion into pisolitic laterite from the Greenbushes mineralized Sn–Ta pegmatite system, Western Australia, in *Geochemical Exploration 1985, Part I edited by R. G. GARRETT*: *Journal of Geochemical Exploration*, v. 28, p. 251–265.