Interpreted bedrock geology of the northern Murchison Domain, Youanmi Terrane, Yilgarn Craton

by

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Newly acquired aeromagnetic data, remote sensing data, pre-existing maps, and some new fieldwork have provided the basis for an interpreted bedrock geology and structural map of the northern part of the Murchison Domain of the Youanmi Terrane (Cassidy et al., in prep.), and a small part of the southeastern part of the Narryer Terrane. The map extends from the Jack Hills Belt in the northwest to the Youanmi Shear Zone in the southeast, and covers the map sheets of BELELE*, CUE, KIRKALOCKA, the northern part of NINGHAN, the western thirds of GLENGARRY, SANDSTONE, and YOUANMI, and the northwest of BARLEE. The map was created in a GIS program to provide the best spatial accuracy possible, and to use the datasets as layers to maximize the amount of information at particular points as an aid to interpretation. It includes new structural interpretations, and adds to the understanding of the geology under cover. The geology is dominated by greenschist- to lower amphibolite-facies Archean granites and greenstones, and includes large layered intrusions in the southern part of the area. Limited geochronological studies undertaken in the Murchison Domain show that most greenstones and granitic rocks were deposited or emplaced between c. 3000 and c. 2600 Ma.

Interpretation of the new aeromagnetic images (Fig. 1), combined with other datasets and fieldwork, has allowed preliminary revision of the published maps and structural schemes. This will be updated as more detailed 1:100 000-scale mapping is carried out by GSWA in the Murchison Domain. It is apparent that the dominant regional structures are northeast-trending and north- to northwest-trending folds, faults, and shear zones. Early east-trending folds (D_2 of Watkins and Hickman, 1990) are preserved locally, but may be confined to the west of a major west-dipping thrust, here named the Carbar Fault, that separates two distinctive regions of different structural style, with the western side (including the Weld Range and Mingah Range greenstone belts) less shear dominated and preserving more evidence of an earlier structural history.

East of the Carbar Fault, and west of the Mount Magnet Fault and Polelle synform, is the newly identified, Meekatharra structural zone. This is a major, northeast-trending shear-dominated zone, about 50 to 60 km wide, incorporating the Meekatharra area, and extending through the Cue region as far south as Mount Magnet (taking in a large part of the Meekatharra–Wydgee greenstone belt). At Mount Magnet the structural zone changes to a northerly trend where faults and shears cut through granitic rocks and the Windimurra and Narndee Intrusions. In the aeromagnetic images southwest of the Windimurra Intrusion, and within the inferred continuation of the Meekatharra structural zone, tight north-trending folds are evident within interpreted granitic rocks under cover. One of the main structures within the northern part of the zone is the northeast-trending Chunderloo Shear Zone, which has a dextral sigmoidal pattern in the aeromagnetic images, and is dominated by dextral kinematic indicators in the field. Similarly oriented, dextral shear zones can be seen in the aeromagnetic images within the likely southern continuation of the Meekatharra structural zone, one of which cuts across the northwestern margin of the Narndee Intrusion.

There is very little control on the age of the main deformation events throughout the Murchison Domain, but most granitic rocks show at least some effects of deformation, much of which may have been strongly partitioned within the granite–greenstone sequences. Dating of zircons from ‘post-folding’ or ‘post-tectonic’ granites and deformed granites has shown that, in some instances, the undeformed granites are older than the deformed granites (Schiøtte and Campbell, 1996). This indicates that the effects of deformation are heterogeneous due to rheology contrasts and strain partitioning, and that the granites cannot be divided stratigraphically on the basis of foliation or fold development. Part of the structural complexity in the region also arises from the possibility of co-planar or co-axial reactivation or reworking of older structures, such as potential early east-trending folds being overprinted by much younger, east-trending structures, as well as by Mesoproterozoic dykes. Large, approximately easterly trending shears and faults cut the Jack Hills greenstone belt in the northwest (Narryer Terrane), and appear to extend sufficiently south to at least truncate the northern part of the Mingah Range greenstone belt. In

* Capitalized names refer to standard 1:250 000 map sheets.

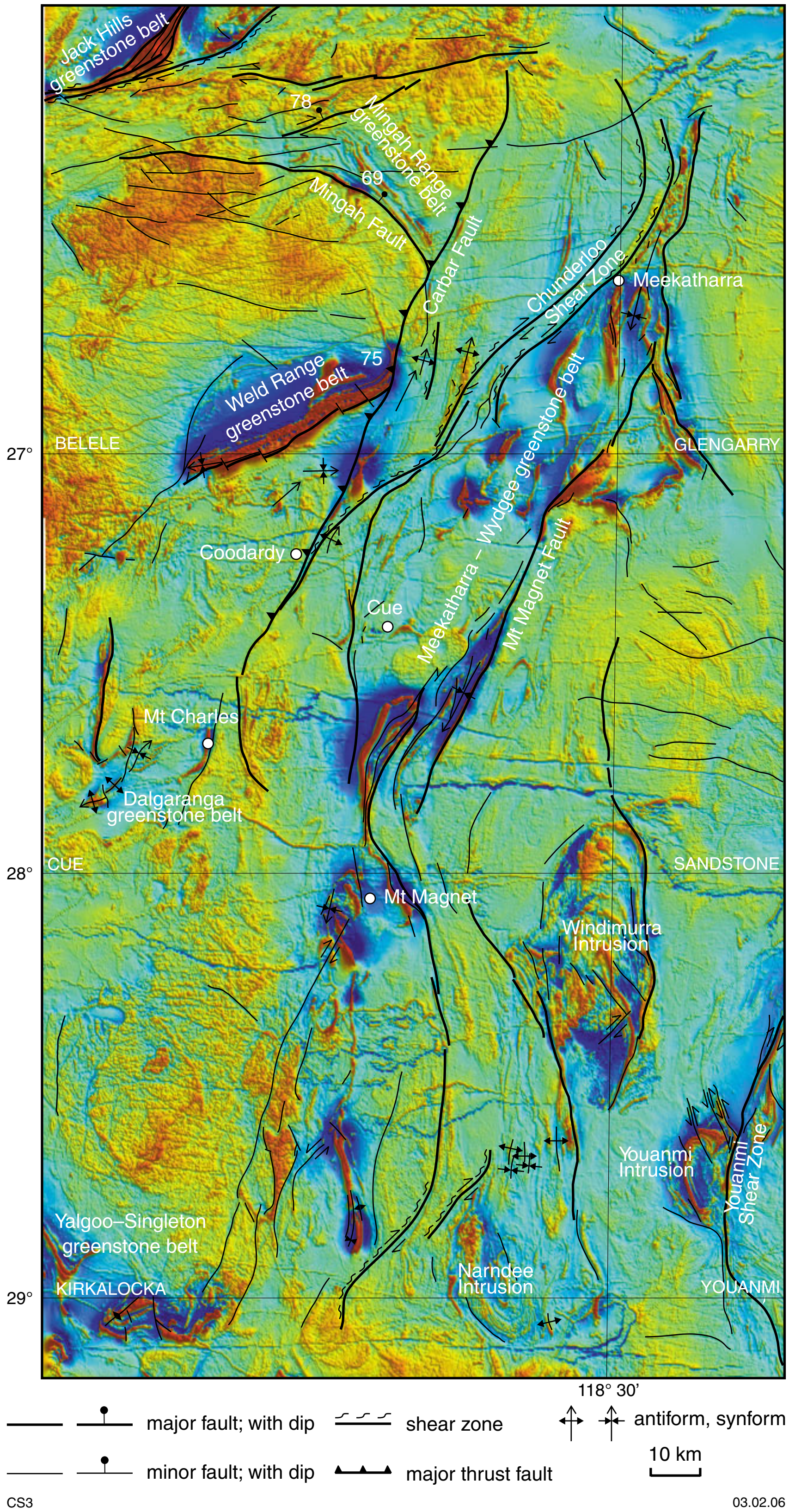

Figure 1. Simplified interpreted structural map of the northern Murchison Domain showing localities and major structures, overlain on a reduced to pole total magnetic intensity image. Structures shown are derived from the interpreted bedrock geology map in GSWA (2006), Hallberg (2000), GSWA's 1:250 000-scale geological series map sheets, and the Watkins and Hickman (1990) 1:500 000 geological map

the Jack Hills region, these structures are part of a major, dextral transpressive shear zone. Structural analysis and Ar–Ar ages from white micas from sheared rocks in the Jack Hills greenstone belt suggest that this structure formed during the Paleoproterozoic Capricorn Orogeny, but may also be a reactivated older structure, perhaps related to formation of the Narryer Terrane and Youanmi Terrane boundary.

The most widely published structural model of the region (Myers and Watkins, 1985; Watkins and Hickman, 1990) was largely based on the interpretation of localized domical patterns as antiformal domes, produced by superimposed folding episodes at high angles that post-dated magmatism. This interpretation, and the structural chronological scheme associated with it, was extrapolated across the entire domain. However, the structure of the Murchison Domain is complex, and is most likely heterogeneous across different parts of the domain. An understanding of the 3D geometry, revision of the structural chronology, timing of deformation relative to magmatism, and detailed mapping are required to test the previous model. In the interpreted bedrock geology map presented here no attempt has been made to fit the lithological units into a stratigraphic scheme. The limited available geochronological data has shown that the stratigraphy for the Murchison Domain (Murchison Supergroup of Watkins and Hickman, 1990) is problematic, and further work is required to establish primary relationships, especially within the greenstones.

References

CASSIDY, K. F., CHAMPION, D. C., KRAPEZ, B., BARLEY, M. E., BROWN, S. J. A., BLEWETT, R. S., GROENEWALD, P. B., and TYLER, I. M., in prep., A revised geological framework for the Yilgarn Craton: Western Australia Geological Survey, Record.

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA, 2006, Murchison geological exploration package, February 2006 update.

HALLBERG, J. A., 2000, Notes to accompany the Hallberg Murchison 1:25 000 geology dataset 1989–1994. J. A. Hallberg and Associates: Western Australia Geological Survey, Record 2000/20, parts 1–6.

MYERS, J. S., and WATKINS, K. P., 1985, Origin of granite–greenstone patterns, Yilgarn Block, Western Australia: Geology, v. 13, p. 778–780.

SCHIØTTE, L., and CAMPBELL, I. H., 1996, Chronology of the Mount Magnet granite–greenstone terrain, Yilgarn Craton, Western Australia: implications for field based predictions of the relative timing of granitoid emplacement: Precambrian Research, v. 78, p. 237–260.

WATKINS, K. P., and HICKMAN, A. H., 1990, Geological evolution and mineralization of the Murchison Province, Western Australia: Western Australia Geological Survey, Bulletin 137, p. 267.