The Burtville Terrane: the Far East of the Yilgarn Craton

by

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Introduction

The past 25 years have seen a wealth of new data generated in the east Yilgarn as a result of regional 1:100 000-scale mapping programs by the Geological Survey of Western Australia (GSWA) and Geoscience Australia, the acquisition of regional-scale geophysical data, particularly aeromagnetic and gravity data, numerous academic studies of mineralization and mineral deposits, and research programs carried out under the auspices of AMIRA International Limited, the Minerals and Energy Research Institute of Western Australia (MERIWA), and the Predictive Mineral Discovery Cooperative Research Centre (pmd*CRC).

One outcome of all of this new work has been the subdivision of the Yilgarn Craton into six terranes (Fig. 1; Cassidy et al., 2006). The distribution of these terranes is based on rock associations, geological structures mapped in the field and identified in seismic profiles, geochemistry, geochronology, and Sm–Nd isotope data. The three easternmost terranes form the Eastern Goldfields Superterrane, with the Burtville Terrane in the far east, the Kurnalpi Terrane in the centre, and Kalgoorlie Terrane in the west. The three terranes of the Eastern Goldfields Superterrane have been interpreted as a series of continental margin fragments that were amalgamated and then accreted onto the protocratonic nucleus of the Yilgarn Craton (i.e. the Youanmi Terrane; Barley et al., 2003; Cassidy et al., 2006). Lithostratigraphic packages within terranes have been assigned to a series of domains, but relationships between different domains and even some of the bounding structures between the various domains and terranes remain under review.

The Kalgoorlie Terrane (2.71 – 2.66 Ga) is predominantly composed of mafic–ultramafic successions that are overlain by, and locally interleaved with, felsic volcanic and volcaniclastic rocks. The Kurnalpi Terrane contains a wide spectrum of rock associations with the youngest rocks comprising 2.69 – 2.68 Ga felsic calc-alkaline and bimodal rhyolite–basalt complexes along its western side. Other rock types through the rest of the Kurnalpi Terrane (mainly 2.72 – 2.70 Ga) include mafic and ultramafic volcanic, mafic intrusive, calc-alkaline volcanic and volcaniclastic, and medium- and fine-grained clastic sedimentary rocks. The Laverton Domain in the northeast of the Kurnalpi Terrane (Fig. 1) contains mafic, ultramafic, and felsic volcanic and volcaniclastic rocks, banded iron-formation, and clastic sedimentary rocks that are apparently significantly older than those in the eastern part of the terrane, with maximum depositional ages of clastic sedimentary rocks of 2.81 Ga, and possibly 2.86 Ga.

The Burtville Terrane, the least well documented of the terranes, is separated from the adjacent Kurnalpi Terrane by the regional-scale Hootanui Fault (Fig. 1). Prior to the current mapping program, little new data had been collected in this area since the 1:250 000-scale mapping in the 1970s. However, reconnaissance-scale geochronological studies suggested that it contains older greenstones and granites than the terranes to the east.

The northeast Yilgarn Craton project

The current GSWA northeast Yilgarn Craton mapping project, covering the granites and greenstones of the northeasternmost part of the Yilgarn Craton, commenced in 2005. Fieldwork is largely complete in the Mount Venn, Mount Sefton, and Ulrich Range greenstone belts, with the Yamarna – Mount Gill, Dorothy Hills, Mount Hickox, and Irwin Hills greenstone belts to be mapped in 2007.

The Mount Venn greenstone belt is an upright, north-northwesterly trending syncline. The greenstones have a parallel sheared contact with the granitic gneisses to the east, and several late granites cut the belt. The lowermost greenstones are schistose mafic–ultramafic volcanic rocks, with minor interbedded banded iron-formation and quartzite units preserved on the western limb. On the eastern limb the package is intruded by parallel thin pyroxenite, leucogabbro, and dolerite sheets. These intrusive rocks thicken significantly to the north, forming the thick composite gabbroic complex at the northern end. The mafic–ultramafic package is overlain by interbedded sandstone and siltstones, which are in turn overlain by well-bedded felsic tuffs and volcaniclastic rocks that have a sensitive high-resolution ion microprobe (SHRIMP) U–Pb zircon age of 2769 ± 2 Ma. These grade up into volcaniclastic rocks interbedded with andesitic flows, which are then overlain by a series of interfingering,

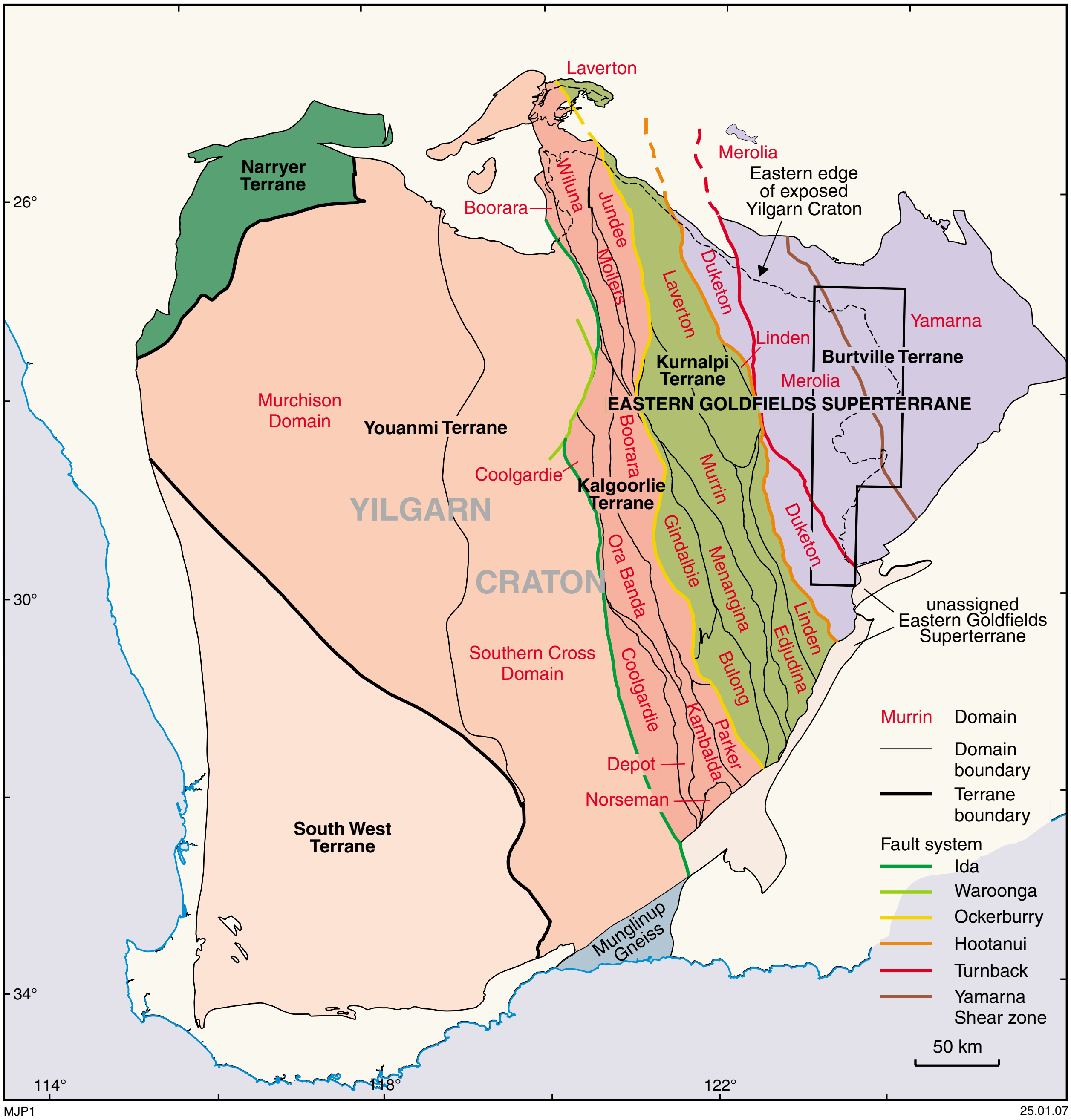

Figure 1. Tectonic division of the Yilgarn Craton, showing the subdivision into superterrane, terranes, and domains. The box in the Burtville Terrane shows the area of the current mapping programme, and the dashed line shows the edge of the exposed Yilgarn Craton. Figure modified from Cassidy et al. (2006)

wedge-shaped rhyolitic and dacitic bodies. The felsic rocks preserve a transition from distal to proximal facies. The uppermost part of the succession is intruded by layered gabbros of the Mount Venn complex.

Based on overprinting relations, a provisional three-stage deformation history can be constructed for the Mount Venn greenstone belt. The first recognized deformation event is characterized by well-developed, down-dip (i.e. east-plunging) stretching lineations and parallel fold hinges in banded iron-formation on the western side of the belt. The folds are isoclinal and intrafolial with axial planes concordant with the steeply to moderately dipping, north-northwesterly trend of the belt. The folds are typically asymmetric, but the vergence varies along the unit, suggesting sheath-like geometries (consistent with the parallel stretching lineations and fold hinges). A second deformation resulted in overprinting of the stretching lineation by upright open folds that plunge to the south-southeast (i.e. along the strike of the belt) at a shallow to moderate angle. These local F_2 folds have a consistent 'Z' asymmetry, indicating a westward vergence.

Similar relations were observed on the eastern side of the Mount Venn greenstone belt. Volcaniclastic rocks with a bedding-parallel, solid-state foliation are folded into upright tight 'S' folds that moderately plunge to the south-southeast. To the south, talc–chlorite schists are folded into similarly oriented structures (i.e. eastward vergence). The folded schists have a well-developed crenulation cleavage that is aligned subparallel to the limbs of the fold, suggesting that there might be a composite fabric (i.e. local S_1/S_2) along the belt. The massive granites at Lang Rock have a high-angle veined contact with the north-northwesterly trending greenstones, suggesting that they were emplaced following local D_2. In turn, the granites and greenstones are cut by a series of east-northeasterly trending quartz veins, interpreted as products of local D_3, with en echelon quartz vein arrays indicating an apparent dextral sense of shear.

The change in composition from mafic–ultramafic to felsic volcanism is also observed in the Duketon greenstone belt (e.g. Barley et al., 2003), suggesting that there may be a consistent stratigraphy across the terrane. The age of c. 2770 Ma from the middle of the described section is younger than the sequence in the Duketon greenstone belt (i.e. 2805 Ma), but does support the hypothesis that the Burtville Terrane comprises older rocks than the neighbouring terranes. It is possible that the older (>2.8 Ga) northeastern part of the Kurnalpi Terrane (i.e. the Laverton Domain) would be more appropriately assigned to the Burtville Terrane, suggesting that major movement on the Hootanui Fault post-dated the dominant period of terrane assembly.

The provisional sequence of deformation events in the greenstones can be broadly reconciled with those presented for the western Burtville Terrane and other parts of the Eastern Goldfields Superterrane. The prominent Yamarna Shear Zone is probably in the same generation of structures as the Hootanui Fault.

Mineralization

Although the area has been explored for gold and other commodities since the 1890s, there is little recorded production. However, the acquisition of new geophysical data, particularly aeromagnetic and seismic data, has generated new interest in the region, particularly after the discovery of the Tropicana gold deposit to the southeast.

References

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