# Localized metasomatic alteration and mineralization of the Mount Belches Formation, southern Eastern Goldfields, Western Australia

by

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Orogenic gold mineralization hosted by the Mount Belches Formation is located about 80 km east-southeast of Kalgoorlie. Mapping of the MOUNT BELCHES 1:100 000 sheet has revealed metasomatic alteration, similar to that at known deposits, scattered throughout the area. Many of these alteration zones occur in areas that are structurally favourable for gold mineralization.

The Mount Belches Formation (formerly Mount Belches Beds) comprises a sequence of metamorphosed greywacke with subordinate mudstone, banded iron-formation (BIF), Fe-mudstone and chert. Locally abundant sedimentary structures and features, which include Bouma sequences, ripples, cross-laminae, channels and soft-sediment deformation, are minimally affected by lower amphibolite facies metamorphism. Owing to the degree of metamorphism, dominant rock types are classified as psammites and psammopelites; pelites are relatively uncommon. Pelitic portions of beds are generally biotitic (Dunbar and McCall, 1971) but andalusite, sillimanite, garnet and staurolite are observed locally. The formation has been interpreted as a submarine fan of flysch facies (Dunbar and McCall, 1971).

The Mount Belches Formation forms a regional domal anticline that is probably due to interference of $F_1$ and $F_2$ folds (Fig. 1). Thrusting during $D_1$ resulted in northward displacement of a thrust sheet or duplex. A broad east–west trending arch resulted, with a northerly exposure of BIF most probably representing a frontal recumbent fold. $S_1$ is locally observed and is generally layer parallel. In the centre of the map sheet, $S_1$ is approximately flat lying and is locally crenulated by $S_2$. Peak metamorphism accompanied east–west shortening during $D_2$, resulting in the distinctive chevron folds of the BIF unit and a pervasive northerly to north-northwesterly trending subvertical $S_2$ foliation. Isoclinal folds adjacent to the Randalls Fault are probably the result of later movement during $D_3$ and $D_4$ (Witt, W., 1998, pers. comm.). Using aeromagnetic data in conjunction with field observations, major fault traces have been realigned, and several fault jogs have been interpreted along the Mount Monger and Cowarna Faults (Fig. 1).

Orogenic gold mineralization at Randalls and Karnilbinia represents the two major occurrences of gold in the Mount Belches Formation. Up to March 1997, 3 222 700 t of ore at 3.2 g/t yielded 10 300 kg of gold from these deposits. The mines are currently inactive. Economic gold mineralization is hosted by BIF units in post-$D_2$ shallow-dipping quartz veins and associated sulfidic alteration haloes. This mineralization is located in the overturned anticlinal hinge zones and immediately adjacent eastern limbs (Newton et al., 1998).

Alteration style within the mines is dependent upon host lithology. The BIF hosts an assemblage of magnetite, cummingtonite/grunerite, hornblende, actinolite, biotite, chlorite, carbo-nate and iron sulfides. Psammites above and below the BIF unit host an alteration assemblage of magnetite, quartz, chlorite and grunerite, with biotite porphyroblasts and minor Ca-amphiboles and carbonates. These alteration zones are distinguished by a lath or rosette habit of the amphiboles and the interstitial granuloblastic quartz (Newton et al., 1998).

Regionally, two distinct styles of alteration are apparent. Most common is a quartz–grunerite(–Ca-amphibole) assemblage, similar to that described for alteration of psammites at Randalls and Karnilbinia. It occurs at a variety of scales, from a few millimetres each side of a quartz veinlet to diffuse patches several metres across to areas several kilometres wide. Altered zones are dispersed irregularly throughout the area (Fig. 1). Less abundant is alteration with a quartz–carbonate(–chlorite–magnetite) assemblage. Such alteration has been observed only as diffuse patches south of Karnilbinia and in greenstones in the Bulong Anticline of the Gindalbie terrane (Fig. 1).

Alteration assemblages such as these are considered part of a continuum that represents metasomatism under varied conditions. Carbonate-bearing alteration represents upper greenschist facies alteration whereas the amphibolitic alteration represents lower amphibolite facies alteration (Groves et al., 1995).

Essential parameters for orogenic gold mineralization include competency contrasts, a localized low-stress

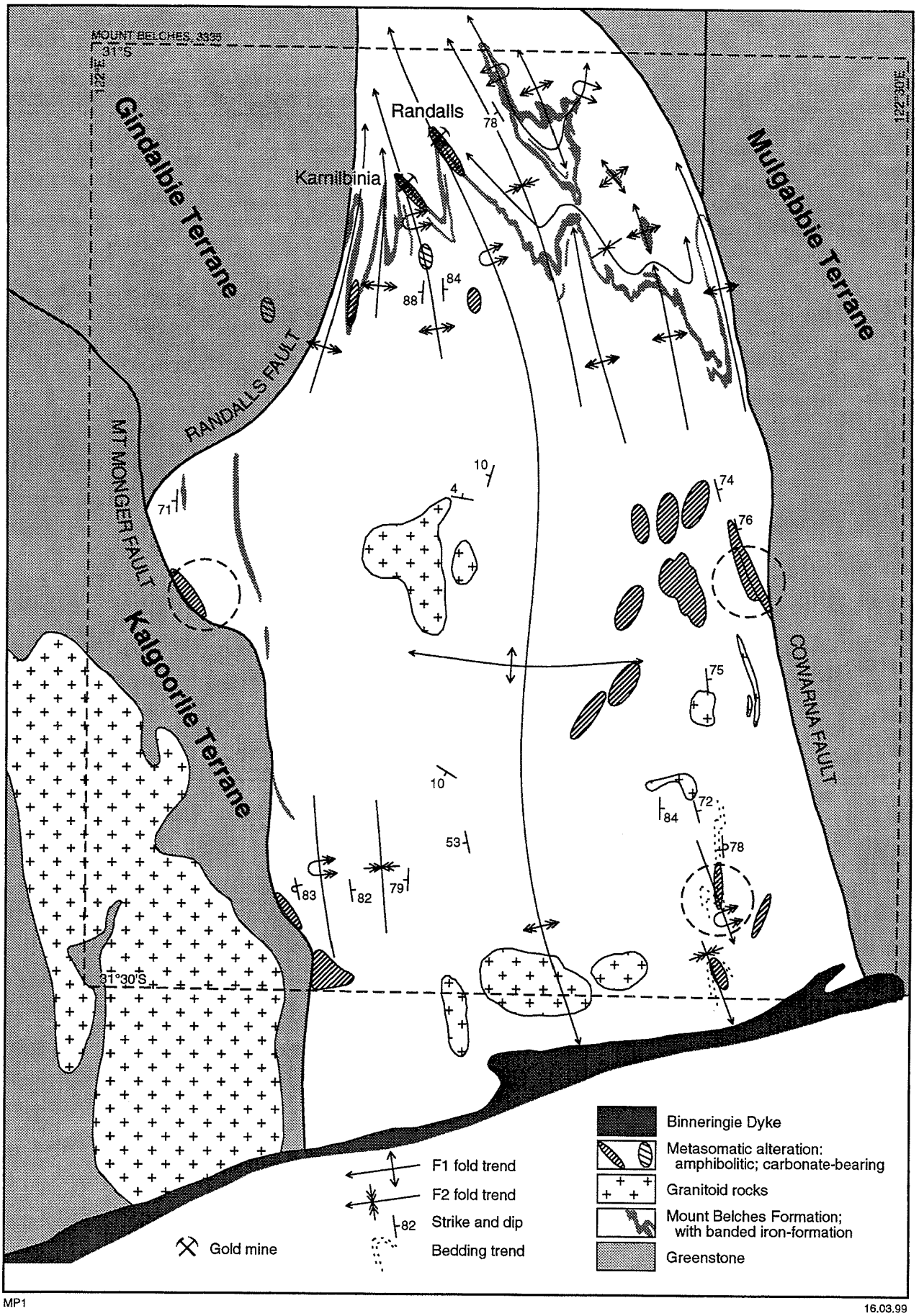


**Figure 1. Interpreted Archaean geology of the Mount Belches Formation (after Swager, 1995), showing structure and alteration zones. Dashed outline represents the boundary of the MOUNT BELCHES 1:100 000 sheet**

regime and rock interaction with low salinity, and auriferous $H_2O$–$CO_2$(–$CH_4$) fluids (Groves et al.,1995). At Randalls and Karnilbinia, these criteria are met because the ore is associated with BIF horizons within a psammite sequence, hinge zones of overturned anticlines, and alteration. Elsewhere, zones of intense hydrothermal alteration often coincide with sites of structural dilatancy. Such sites include the fault jogs on the Mount Monger and Cowarna Faults, and the large-scale, south-plunging, overturned, parasitic folds on the regional $F_2$ anticline (e.g. Fig. 1 — circled areas). Although few BIF units are apparent to the south, other units, such as sandstones in the poorly understood facies architecture of the Mount Belches Formation, could provide the necessary competency contrasts. The broad alteration zones in the east-central area of the map sheet are deeply weathered and controls on their distribution remain obscure.

Given the coincidence of these features, there is potential for orogenic gold mineralization elsewhere in the Mount Belches Formation. The lack of BIF to the south, however, suggests that any such deposits, should they exist, would not resemble the Randalls and Karnilbinia deposits, but would instead be hosted by different lithologies.

# References

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