Geology and tectonic evolution of the Early Proterozoic Glengarry Basin, Western Australia

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Abstract

The Early Proterozoic Glengarry Basin is located on the northern margin of the Archaean Yilgarn Craton. The inception and evolution of the basin was due to the formation of pull-apart openings during regional-scale strike-slip movements resulting from the oblique collision between the Pilbara (in the north) and Yilgarn (in the south) Cratons. The history of the basin is recorded in a number of sag- and rift-basin successions (Windplain sag basin, Mooloogool rift, Bryah rift, Padbury basin). These successions include sedimentary (shelf and turbiditic facies) and volcano-sedimentary (shale, clastic, and mafic volcanic and subvolcanic) rock formations. The mafic rocks include the Narracoota and Killara Formations, each with distinct REE and geochemical signatures, indicative of oceanic (Narracoota) and mixed continental–oceanic (Killara) origin. Other tectonic units associated with the evolution of the Glengarry Basin are the Archaean Marymia and Goodin Inliers, and the Peak Hill Schist. The latter is a high-strain domain of the Marymia Inlier and is economically important because it hosts a number of mesothermal lode-gold deposits. Other gold deposits of epigenetic origin occur in the highly deformed and greenschist-facies metamorphosed rocks of the Bryah and Padbury successions. A link with collision tectonics is assumed to explain the origin of the epigenetic mineralization.

KEYWORDS: sedimentary basins, stratigraphic succession, mafic rocks, ultramafic rocks, stromatolites, carbonate rocks, epigenetic deposits, gold, lead, mineralization.

This paper presents an overview of the geology and tectonic evolution of the Early Proterozoic Glengarry Basin based on the results of recent (Adamides, 1995; Dawes and Le Blanc Smith, 1995; Geological Survey of Western Australia (GSWA), 1995; Pirajno and Occhipinti, 1995; Pirajno et al., 1995) and ongoing field mapping, and petrological and geochemical studies. Previous work on the general geology and tectonic history of the Glengarry Basin includes Gee and Grey (1993) and Windh (1992).

The Glengarry Basin (c. 2000–1800 Ma), together with the Earaheedy Basin, the Ashburton Basin, and the Gascoyne Complex, is included in the Capricorn Orogen. The Capricorn Orogeny took place approximately between 2000 and 1600 Ma (Tyler and Thorne, 1990). Other tectonic units affected by the Capricorn Orogeny include the Archaean Narryer Gneiss Complex, the Marymia Inlier, the Sylvania Inlier, and parts of the Hamersley Basin (Tyler and Thorne, 1990).

The geodynamic evolution of the Capricorn Orogen has been discussed by Myers (1993) and Tyler and Thorne (1990). In general, it appears that the orogen was formed during a series of collision events, brought about by the converging movement of the Pilbara and Yilgarn Cratons.

The model proposed by Myers (1993, p. 468, fig. 5) suggests that subduction systems and 2000–1800 Ma oceanic crust were present between the Pilbara and Yilgarn Cratons. These subduction systems consisted of a south-facing volcanic arc and an Andean-type magmatic arc, developed on the northern margin of the Yilgarn Craton. The intervening ocean closed between 1800 and 1700 Ma, and oblique collision occurred between the rifted passive margin on the Pilbara side and the active margin on the Yilgarn side. The southern side of the Pilbara Craton was sliced up by major thrusts, whereas most of the tectonic transport (and obduction) of arc volcanic rocks was towards the south onto the Yilgarn Craton.

It is in this tectonic environment that the Glengarry and Earaheedy Basins were formed on the northern margin of the Yilgarn Craton (Fig. 1). The Glengarry Basin, together with the Earaheedy Basin, was considered as part of a greater structure called the Nabberu Basin (Gee, 1990; figs 3–6). However, the Earaheedy Group appears to be younger, as indicated by a number of its outliers that unconformably overlie the Glengarry Group, and for this reason the Glengarry Basin is considered as a separate entity.

According to the model proposed by Tyler and Thorne (1990), the Glengarry Basin could have developed as a back-arc structure during the convergence of the Pilbara and Yilgarn Cratons. A collision phase followed resulting in thrusting and obduction of oceanic-

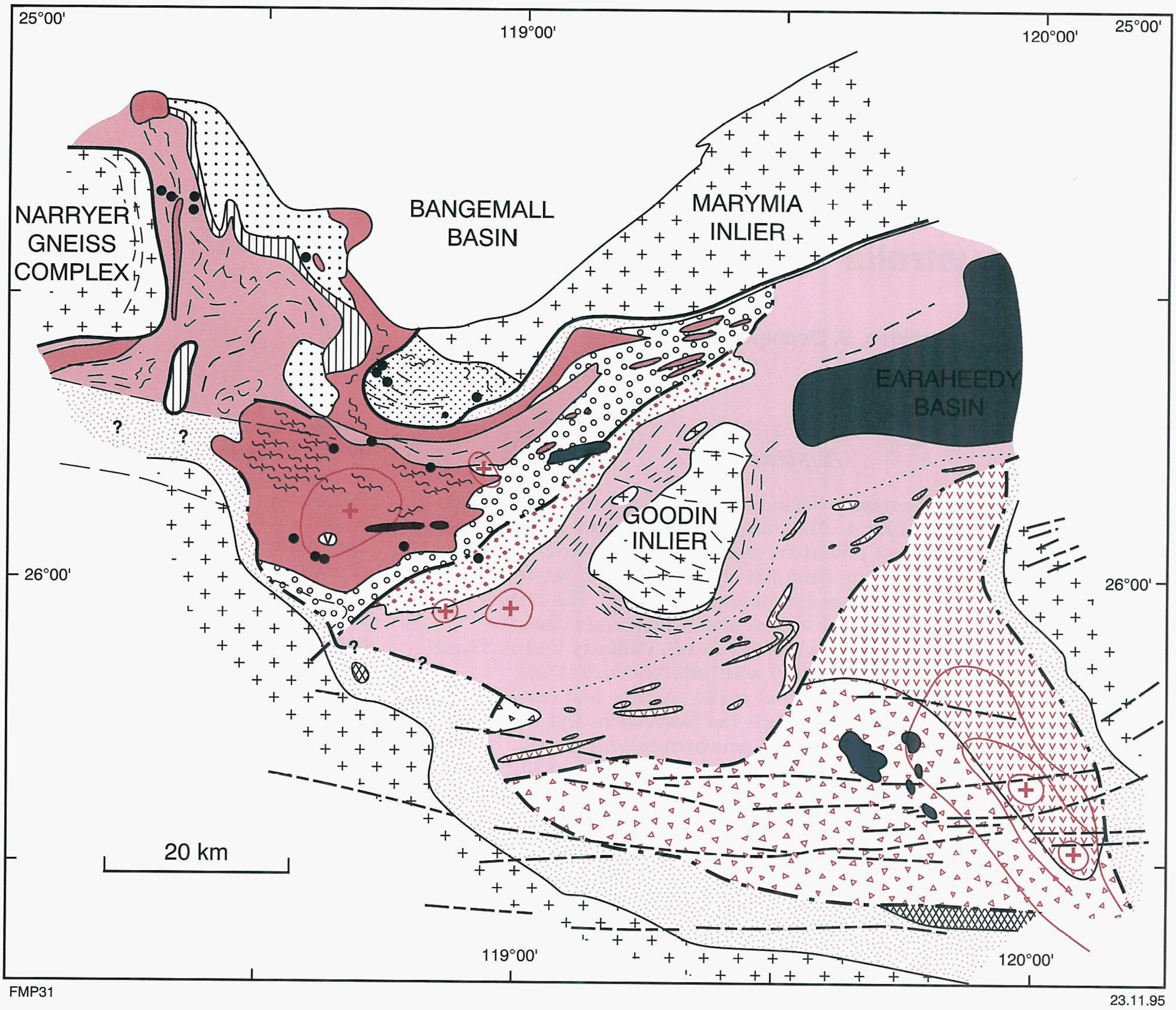


Figure 1. Simplified geological map of the Glengarry Basin (reference is on opposite page). Compiled by integrating data from field observations, airborne magnetics, gravity, and Landsat images. The map below the reference shows the position of the Glengarry Basin in relation to the Capricorn Orogen

crust material towards the south (and ?east) over the Narryer Gneiss Complex (e.g. the Trillbar Complex).

Ongoing detailed geological mapping and study of the Glengarry Basin by the GSWA (e.g. Adamides, 1995; Dawes and Le Blanc Smith, 1995; Pirajno and Occhipinti, 1995, in prep.) has resulted in some modification of these tectonic schemes, at least as far as the development of the Glengarry Basin is concerned. For example, the mafic extrusive and intrusive rocks of the Glengarry Basin are of mixed continental and MORB affinity, and appear to be transitional from west (more oceanic) to east (more continental). This, in itself, suggests a more complex tectonic scenario than previously suggested.

The Glengarry Basin

The Early Proterozoic Glengarry Basin, as originally defined by Gee and Grey (1993), is situated along the northern margin of the Yilgarn Craton, covering an area of approximately 19 250 km². An understanding of the nature of the geological boundaries and margins of the Glengarry Basin is crucial in formulating a model of its tectonic evolution. The boundaries of the basin have the following characteristics (Fig. 1):

- The basin has faulted contacts with the Archaean Narryer Complex in the west, and the Marymia Inlier in the north; these faults are east- and south-verging thrusts.
- In the south and the east, the margins of the basin are characterized by a broad arcuate band of shelf-facies sedimentary rocks that lie unconformably on granite–greenstone rocks of the Archaean Yilgarn Craton. This

Earaheedy Group

PADBURY SUB-BASIN (deformed and metamorphosed)

Padbury Group (Labouchere, Robinson Range, Millidie, Beatty Park, Heines and Wilthorpe Formation) — Padbury Group

BRYAH RIFT SUCCESSION (deformed and metamorphosed)

Horseshoe Formation: BIF and wackes

Ravelstone Formation: clastic rocks

Narracoota Formation: mafic–ultramafic volcanic rocks, intercalated sedimentary rocks

Karalundi Formation: conglomerate, quartz wacke

(Horseshoe to Karalundi Formations: Bryah Group)

MOOLOOGOOL RIFT SUCCESSION (deformed)

Thaduna and Johnson Cairn Formations: arkose, shale, lithic wacke and minor carbonate units. Intercalated with Killara mafic rocks in the southeast

Doolgunna Formation: mixtite and other clastic rocks

Northern limit of Killara Volcanics

Maraloou Formation: black shale, siltstone, and carbonate units

Killara Formation: mafic extrusive and intrusive rocks; intercalated upward with Maraloou Formation beds

WINDPLAIN SAG-BASIN SUCCESSION (undeformed)

Bubble Well Formation: evaporite beds and stromatolitic carbonates, now silicified

Finlayson and Juderina Formations: arenite, minor pebble conglomerate, and carbonate units

(Thaduna to Finlayson and Juderina Formations: Glengarry Group)

ARCHAEAN BASEMENT

Peak Hill schists

Granitoid and gneissic rocks

Domain/sequence boundary

Aeromagnetic lineament (associated with microgabbro dykes)

Positive Bouguer gravity anomaly

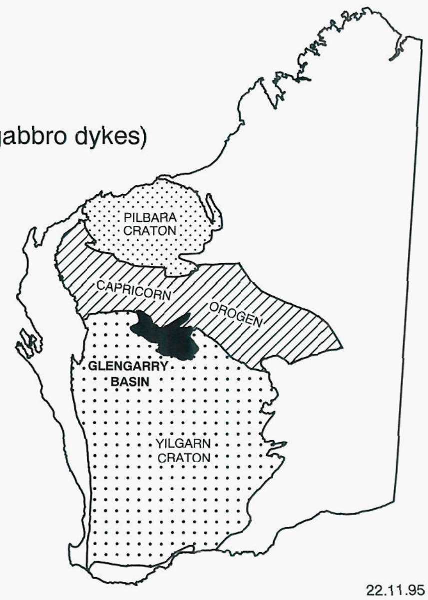
Fault/shear zone

Thrust or fault

Volcanic centre

Trend lines

Mesothermal lode-gold deposit



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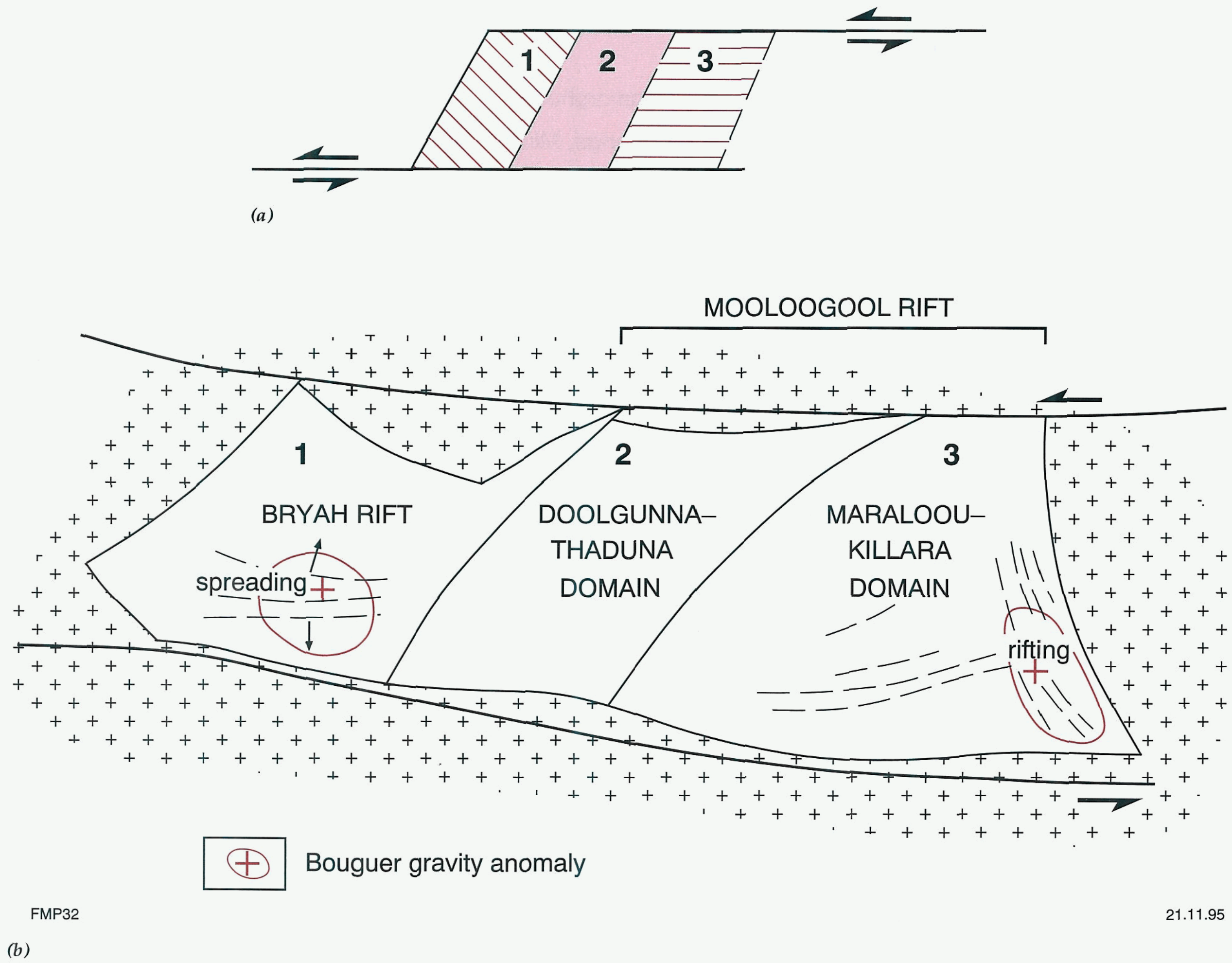


Figure 2. Schematic pull-apart model for the Glengarry Basin. (a) Development of rhomb-shaped pull-apart opening(s) during strike-slip movements; (b) formation of two first-order basin structures (Bryah and Mooloogool rifts) during easterly oriented (?sinistral) strike-slip movement along the northern margin of the Yilgarn Craton. Original irregularities (bends) in this margin may have dictated the actual geometry of the basin structures; the strike-slip movement may have been initiated during a convergent-oblique (transpressive) tectonic regime. Oblique convergent plate boundaries are commonly characterized by wide orogenic zones and strike-slip fault zones, as is the case for the Capricorn Orogen. The extension is relatively 'thin-skinned', with localized areas or zones of upwelling of mantle-derived melts. A well-known example of a thin-skinned strike-slip basin is the Vienna Basin in the Alpine–Carpathian Orogen (Royden, 1985)

contact relationship is typically tectonically undisturbed, in contrast to the above-mentioned highly tectonized northern and western boundaries with the Marymia and Narryer tectonic units.

- In the north-central portion a roughly square-shaped granitic inlier (Goodin Inlier) constitutes a fragment of an Archaean terrane surrounded by Glengarry clastic lithologies. The southern margin of the Goodin Inlier has southerly dipping faulted contacts with the Glengarry rocks.
- In the northeast, the boundary of the Glengarry Basin is adjacent to the Earaheedy Basin (Gee, 1990), but no contact relationships can be observed due to the Recent cover. Elsewhere, as discussed below, Earaheedy Basin outliers unconformably overlie the Glengarry rocks.
- In the northwest, the Glengarry Basin is unconformably overlain by rocks of the Bangemall Basin (Muhling and Brakel, 1985). Outliers of the Middle Proterozoic Earaheedy Group (forming the Earaheedy Basin) occur in the southeast (Yelma Formation) and in the west (Mount Leake Formation).

As mentioned above, the inception and evolution of the Glengarry Basin is related to the convergence of the Pilbara and Yilgarn Cratons during the Capricorn Orogeny. The back-arc model envisaged by Tyler and Thorne (1990) is a possibility. However, on the basis of the recent work carried out by the GSWA an alternative model is proposed. In this model the Glengarry Basin formed in response to east–west transpressive movements that resulted in pull-apart sub-basins as illustrated in Figure 2. These structures were controlled by easterly trending sinistral strike-slip fault systems that characterize the Capricorn Orogen. It is commonly accepted that strike-slip zones may be related to oblique-convergent (transpressive) movements, as is in fact envisaged for the Capricorn orogenic system (Myers, 1993).

Field observations integrated with photogeological, Landsat, and aeromagnetic image interpretations suggest that the Glengarry Basin, as defined by Gee and Grey (1993), comprises the following tectonostratigraphic units or domains: the Windplain sag basin, the Mooloogool rift succession, the Bryah rift succession, the Peak Hill Schist, and the Padbury basin succession. For the sake of convenience the name Glengarry Basin is retained as a comprehensive term to include all the above successions, which are characterized by different stratigraphies, structures, metamorphism, and associated mineral deposits. Scattered outliers of nearly flat-lying and undeformed rocks of the Earaheedy Group overlie the Bryah and Mooloogool rift successions. The outliers of the Earaheedy Group consist mainly of glauconite-bearing siliciclastics in the west (Mount Leake Formation) and stromatolitic units in the southeast (Yelma Formation).

A simplified geological map of the Glengarry Basin is shown in Figure 1, the salient features of which are described below.

The Glengarry Basin was possibly initiated as an extensional sag structure, which later developed into rift sub-basins. This resulted in the Windplain sag-basin succession, which consists of an unmetamorphosed and largely undeformed sedimentary basinal succession. This sag phase is characterized by an extensive apron of siliciclastic, carbonate, and evaporitic sedimentary rocks, which were probably deposited in an epicontinental environment. These sedimentary rocks are largely exposed along the southern, eastern, and northeastern margins of the basin. Remnants of mylonitized siliciclastic units are present along the southwestern margin of the Marymia Inlier. The Windplain sag-basin succession includes the Finlayson Formation (mainly arenite with minor shale and fetid carbonate; Elias et al., 1982), the Juderina Formation (Gee, 1987), and the Bubble Well Formation (silicified evaporitic rocks and stromatolitic dolomite; Dawes and Le Blanc Smith, 1995). Both the Finlayson and Juderina Formations are characterized by basal quartz arenite displaying herring-bone and trough cross-bedding, and multidirectional ripple marks, indicative of shallow-water deposition. It is important to note that no basal conglomerates are present and that the mature quartz arenites of the Finlayson and Juderina Formations rest directly and unconformably on Archaean basement rocks.

The Finlayson Formation has sedimentological characteristics that indicate that it was deposited in extensive intertidal to supratidal and shelf environments (Fig. 3). Judging by the presence of isolated outliers, approximately 60 km south (e.g. Mount Agahong, GLENGARRY* (1:250 000)), and 36 km southeast (e.g. WILUNA (1:100 000); Liu et al., this volume) of the southern unconformable contacts of the Finlayson Formation, the extension of the sag basin must have been substantially greater than presently exposed.

The Juderina Formation in the northeastern part of the basin consists of arenite overlain by a lensoidal conglomerate, followed by an interbedded succession of silicified carbonate, shale, siltstone, quartz arenite, and intraformational granular to pebble conglomerate.

The passage from the sag phase to the rift phases is recorded in the southwest (Bryah rift) by the conglomerates and immature clastics of the Karalundi Formation, heralding an abrupt change from a shallow and mature environment to one of high energy. In the northeast (Mooloogool rift) this change is less abrupt and is indicated by the lensoidal intraformational conglomerate beds containing angular and poorly sorted quartz arenite and shale clasts. The conglomerate beds are sharply overlain by shale, and silicified and possibly stromatolitic carbonate. The succession is interpreted to be due to periodic subsidence during high-energy conditions and upward shallowing. Deposition of the overlying Johnson Cairn Formation (Gee, 1987) was in a passive phase that was periodically interrupted by the deposition of turbidites (Thaduna Formation) during later tectonic instability. A thick sequence of turbidites and mixtites (Doolgunna Formation) was deposited in a northeasterly trending horst and graben structure (see Fig. 1).

* Capitalized names refer to standard map sheets.

This entire, predominantly clastic succession is named the Doolgunna–Thaduna domain (Figs 2 and 3). This domain was, at least initially, penecontemporaneous with the Maraloou–Killara domain (Figs 2 and 3), because the southeastern portion of the Doolgunna–Thaduna domain intercalates with mafic rocks of the Killara Formation (see below). This is especially evident in areas close to southern and southeastern margins of the Goodin Inlier, where immature turbidite facies rocks are intercalated with mafic sills and lava flows. In these areas the rift-phase Killara volcanism was locally subaerial and contemporaneous with deposition of the turbidite facies rocks. Penecontemporaneous mass-wasting from the uplifted blocks resulted in the deposition of turbidites with the local 'cannibalization' and scouring of the rift-related volcano-sedimentary rocks. This is evidenced by the presence of lithic blocks and fragments of tholeiitic lavas, shale, and siltstone contained in the turbidites.

The rocks of the Doolgunna–Thaduna domain are variously grouped under the names of the Doolgunna, Johnson Cairn, and Thaduna Formations, reflecting local sources, but all are effectively the result of high-energy terrigenous sedimentation sourced from uplifted blocks of granite-dominated lithologies. A compressional event resulted in the deformation of the above-mentioned formations.

In the south and southeast, the Mooloogool rifting event was characterized by lithospheric thinning, as indicated by the emplacement of voluminous mafic extrusive and intrusive rocks, mainly along easterly trending fissures (Killara Formation). A number of subparallel linear easterly trending structures, indicated on the aeromagnetic imagery, occur in the southern flank of the basin. These easterly trending linear structures correlate with easterly trending microgabbroic dykes, which may have fed the outpouring of the mafic volcanic rocks. In the southeast, positive Bouguer anomalies coincide with the Killara mafic extrusive and intrusive rocks (Figs 1, 2, and 3).

A diamond drillhole, sunk by CRA in 1985, intersected an undisturbed

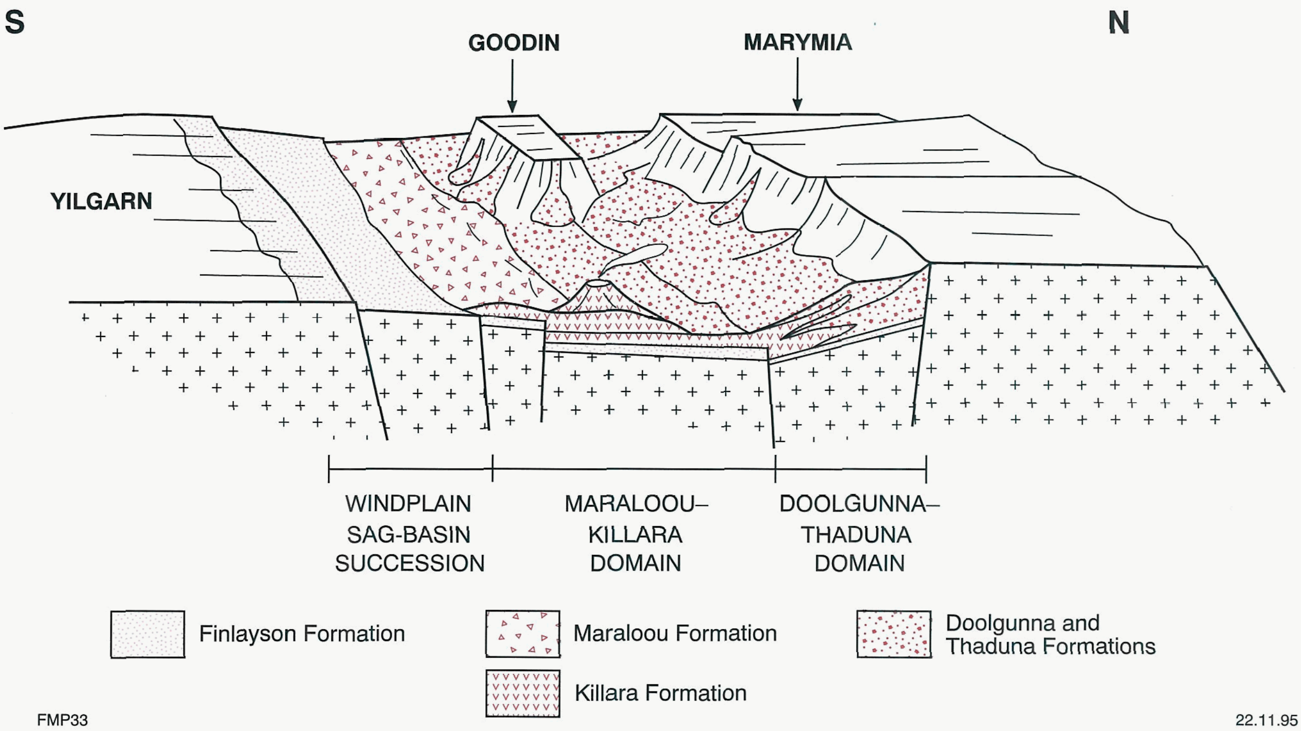


Figure 3. Tectonic and volcano-sedimentary scenario of the Windplain sag basin and Mooloogool rift-succession domains. The initial sag phase is shown by the dotted pattern (e.g. the Finlayson and Juderina Formations); this phase is one of regional-scale subsidence. The rift phase is characterized by faulting due to tensile deviatoric stresses in response to the regional-scale stress field, in this case a strike-slip system. Diagram not to scale

sequence of mafic pillow lavas and microgabbroic sills at a depth of 319 m that extends to the end of the hole at 503 m. These lavas are overlain by flat-lying black shales of the Maraloou Formation (Elias et al., 1982; Pirajno et al., 1995). The Killara Formation and overlying sedimentary rocks of the Maraloou Formation belong to the Mooloogool rift succession (Figs 1 and 3).

The contact between mafic rocks and shales is transitional, and is marked by intercalations of lavas, shales, and sills, with the volcanic component consistently decreasing with stratigraphic height. Drillholes sunk by Carpentaria Exploration near the Killara Homestead in 1984 intersected up to 200 m of mafic extrusive rocks and gabbroic sills. In one hole a total of 15 individual lava flows can be recognized in a 90 m-thick section, suggesting a high rate of eruption. The mafic extrusive rocks are included in the newly defined Killara Formation (Dawes and Le Blanc Smith, 1995). The extrusive rocks are aphyric, undeformed, and unmetamorphosed, or only affected by low-grade greenschist-facies metamorphism. In places, bands of nontronite veins possibly mark the contacts between extrusive rocks and microgabbro sills. The presence of nontronite may be indicative of low-temperature hydrothermal activity associated with submarine mafic volcanism (Murnane and Clague, 1983).

The Killara mafic rocks have subalkaline tholeiitic to calc-alkaline tholeiitic compositions characterized by low REE abundances with a slight LREE enrichment and positive Eu anomalies (Figs 4a,b). Discriminant diagrams for the Killara volcanic rocks suggest a mixed tectonic signature ranging from oceanic-island to continental settings (Fig. 4c).

In summary, field evidence indicates that the Windplain sag basin (Fig. 3) was characterized by siliciclastic sedimentation and evaporitic deposition in supra- and intertidal environments. This was succeeded by rifting in the central parts of the sag basin in deeper water conditions. This rift phase was characterized by the eruption of mafic extrusive rocks and sedimentation in anoxic (black shale) conditions in the central part of the basin. In the northwest of the Mooloogool domain, turbidite-facies sedimentary rocks were deposited close to tectonically unstable rifted margins (e.g. Marymia and Goodin Inliers) in a northeasterly trending depocentre (Figs 1 and 3). In both domains, mafic rift magmatism took place, having an oceanic character in the deeper parts of the basin and a more continental character in marginal areas subject to terrigenous sedimentation.

The Bryah rift succession and Peak Hill Schist occur in the west and northwest of the Glengarry Basin (Bryah Group; Pirajno and Occhipinti, 1995). The former consists of mafic–ultramafic volcanic rocks (Narracoota Formation), turbiditic sedimentary rocks, BIF, and associated clastics (Horseshoe and Ravelstone Formations), all of which are intensely deformed and metamorphosed up to low to mid-greenschist facies. The Peak Hill Schist constitutes a distinct tectonic unit at the southwestern tip of the Marymia Inlier, and consists of quartz sericite schist, mylonitic schist, and quartz mylonites, tectonically interleaved with cataclastic granitic rocks in places. The Peak Hill Schist may represent a high-strain domain that belongs to the Marymia Inlier.

The deformation and metamorphism of the Bryah domain (Bryah Group and Peak Hill Schist) are linked to compression and collision, and eastward indentation from a rigid Archaean block (Narryer Gneiss Complex) in the west and the Marymia Inlier in the north. The Narryer Gneiss Complex and the Marymia Inlier both overthrust the Bryah domain. It is probable that the origin of the epigenetic lode-gold deposits of the Bryah domain may also be related to this tectonism and associated prograde and retrograde metamorphic episodes (see below).

The Narracoota Formation is an important and voluminous component of the Bryah rift succession and consists of ultramafic and mafic schists, and metabasalts displaying hyaloclastite and brecciated textures. Pillow structures occur locally in less-deformed domains of the mafic schist (Pirajno et al., 1995). The Narracoota mafic schist and hyaloclastite metabasalt are subalkaline Fe–Mg-rich tholeiites (with Mg#s* of 59 and 56 respectively), with mixed MORB to oceanic-island and continental tectonic signatures (Figs 5a,b). The ultramafic schist has a high Mg content (Mg# 81.6) and is interpreted to represent metamorphosed subvolcanic and volcanic cumulates (Pirajno and Occhipinti, in prep.). The Narracoota mafic extrusive rocks are characterized by low REE abundances and flat patterns with weak Eu anomalies, possibly reflecting depleted asthenospheric mantle sources (Fig. 5c). A volcanic

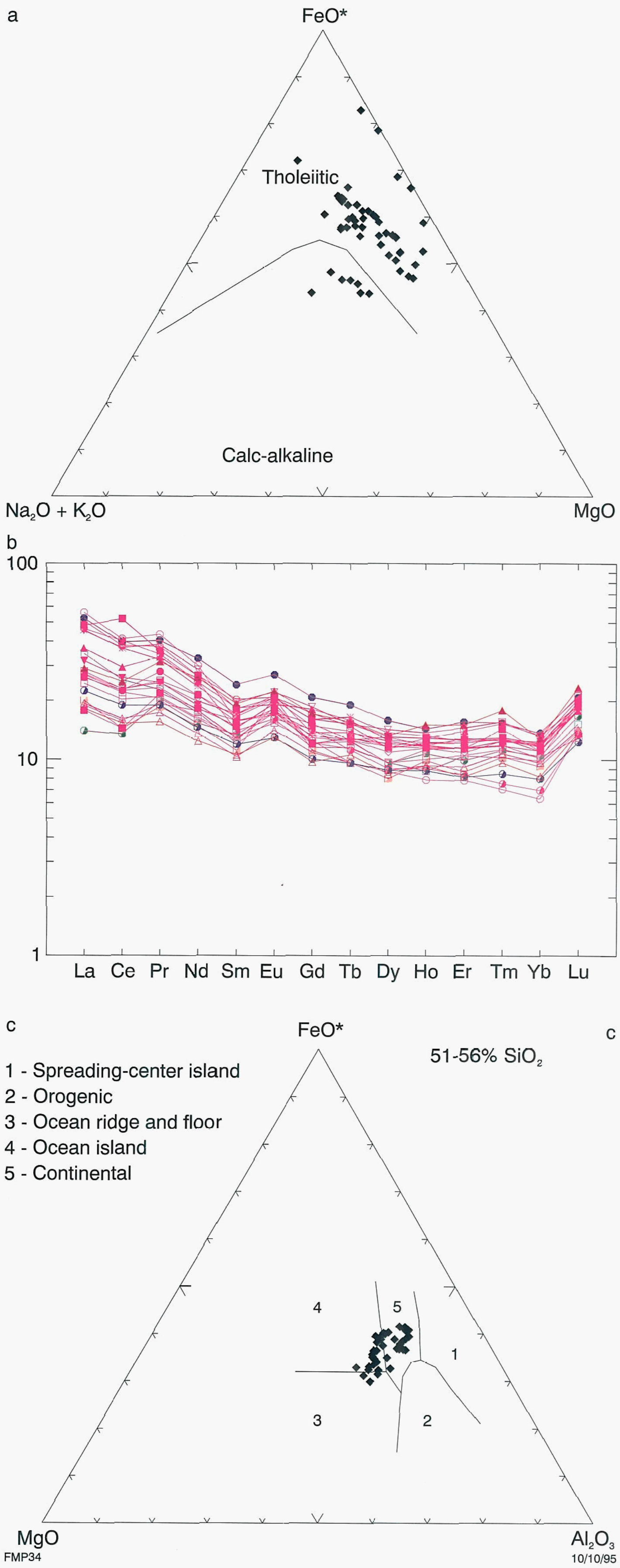
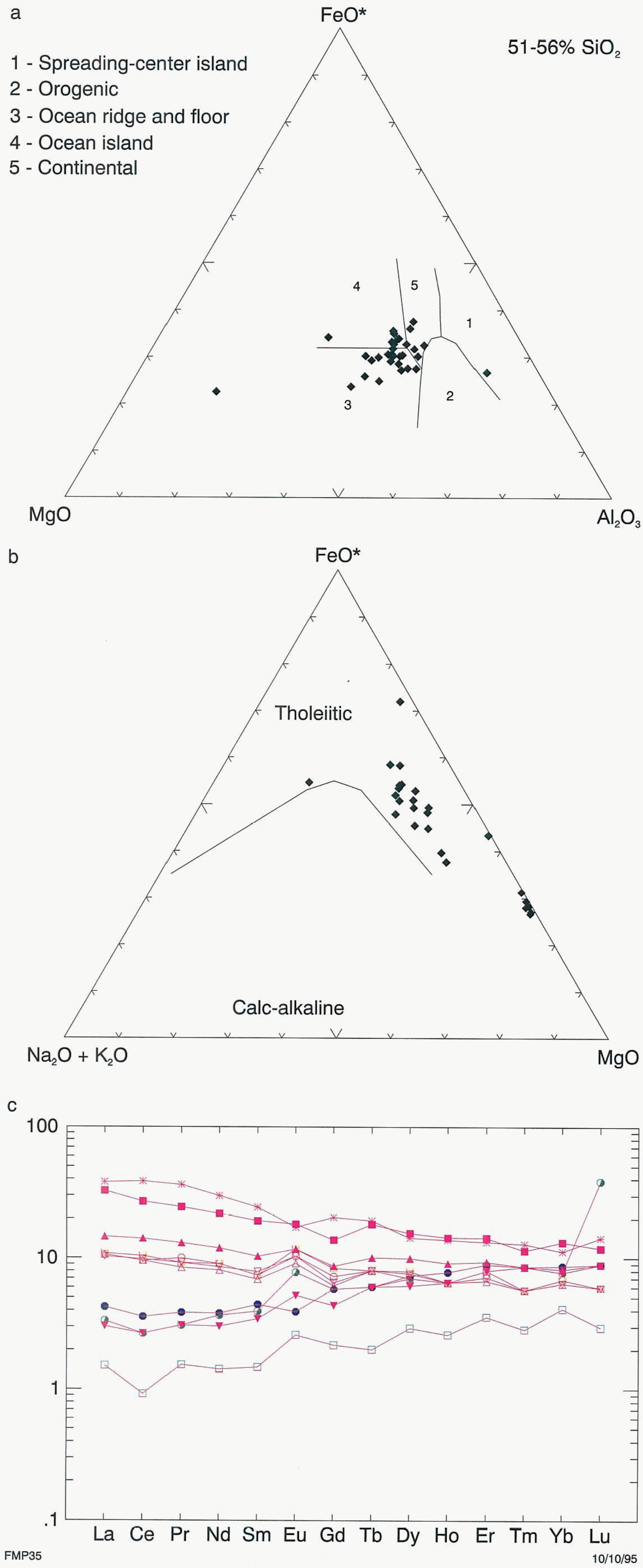


Figure 4. (a) Triangular plot (total FeO–MgO–alkalies (total Fe calculated as FeO); after Irvine and Baragar, 1971) showing the tholeiitic to calc-alkaline character of the Killara mafic rocks

(b) Chondrite normalized REE plot for the Killara mafic rocks (normalizing factors after Sun, 1982)

(c) Discriminant triangular plot (after Pearce et al., 1977) showing the tectonic environments of the Killara Formation

* Mg# = 100 x Mg^{2+} / (Mg^{2+} + Fe^{2+}), where Fe^{2+} represents total Fe.



centre is postulated to exist in the southern part of BRYAH and is coincident with a positive Bouguer gravity anomaly (Figs 1 and 2; Pirajno and Occhipinti, in prep.).

The Padbury foreland basin succession (Martin, 1994) comprises the northwestern portion of the Glengarry Basin of Gee and Grey (1993). This consists of predominantly turbiditic sedimentary rocks (Labouchere, Beatty Park, Heines, Wilthorpe, Robinson Range, and Millidie Formations) that were sourced dominantly from the north (Martin, 1994). Mafic epiclastic rocks are locally present between the Labouchere and Robinson Range Formations. Pyroclastic textures have been recognized in places, and suggest phases of explosive volcanism. Ongoing mapping indicates that the Padbury Group was deposited in a separate basin structure that may not have been part of the pull-apart rift structures (Figs 2 and 3). Evidence for this includes observed faulted contacts between the Padbury and Bryah Groups (Pirajno and Occhipinti, 1995).

The Labouchere Formation was tentatively assigned to the Bryah Group (Bryah rift succession, see below) by Pirajno and Occhipinti (1995). However, on the basis of detailed sedimentological analysis, Martin (1994) assigned the Labouchere Formation, as well as the Robinson Range iron formations, to the Padbury Group. Detailed geological mapping confirms Martin's (1994) stratigraphic subdivisions and supports his interpretations, namely that the Padbury rocks are turbidite-facies sedimentary rocks that filled a localized foreland basin, formed as a result of south-verging thrusting of Archaean units.

Figure 5. (a) Discriminant triangular plot (after Pearce et al., 1977) showing the tectonic environments of the Narracoota Formation

(b) Triangular plot (FeO–MgO–alkalies as for Fig. 4a); after Irvine and Baragar, 1971) showing the tholeiitic character of the Narracoota Formation. The cluster of samples near the MgO apex are ultramafic schists

(c) Chondrite normalized REE plot for the Narracoota mafic rocks (normalizing factors after Sun, 1982)

The relationship between the Padbury Group lithologies and the volcanic rocks of the Narracoota Formation is tectonic. Martin (1994) and Windh (1992) recognized or postulated unconformable surfaces between the Narracoota volcanic rocks and the turbidites of the Padbury Group, but this has not been observed during recent mapping. On BRYAH and elsewhere the contact is sheared or thrusted, and it is considered probable that the Robinson Range Syncline is allochthonous. On MOUNT PADBURY and MILGUN the Narracoota Formation and the Padbury Group have faulted contacts, with the latter being down-faulted against slivers of Narracoota units. In addition, drilling in areas of Recent cover, surrounding outcrops of the Padbury Group, indicate that the region is underlain by mafic and ultramafic rocks belonging to the Narracoota Formation. This suggests either that the lithologies of the Padbury Group were deposited in a flexural foreland basin, as envisaged by Martin (1994), or that they are entirely allochthonous.

Mineralization

Known mineral deposits of the Glengarry Basin are epigenetic and structurally controlled Au (e.g. Peak Hill – Mount Pleasant – Jubilee, Baxter, Fortnum, Labouchere) and Cu lodes (e.g. Thaduna), VMS-type Cu–Au–Ag (e.g. Horseshoe Lights), and supergene Mn (e.g. Ravelstone). All of these occur in the Bryah and Padbury domains except Thaduna, which occurs in the Mooloogool rift succession (Fig. 3). Mineral occurrences in the Mooloogool rift succession include some small shale-hosted and / or carbonate-hosted base-metal gossans.

The discovery of lead carbonate and oxide deposits (cerussite, $PbCO_3$, and plattnerite, PbO_2) within the boundaries of the Glengarry Basin, was announced by Renison Goldfields in 1993 (the resources of one prospect are estimated at about 200 ↔ 10^6 t of Pb ore). This mineralization is hosted in silicified sandstone and stromatolitic carbonate rocks of the Finlayson Formation and the Yelma Formation of the Earaheedy Group. A Pb–Pb model age of the carbonate ore material collected by the GSWA gave a value of 1650 Ma (Le Blanc Smith et al., 1995).

The epigenetic lode-gold deposits in the Bryah domain are economically important. They occur in greenschist-facies metamorphic rocks, and are hosted within high-strain zones in metasedimentary and / or metavolcanic rocks or along their contact zones. The mineralization is associated with relatively narrow zones of hydrothermal alteration. This alteration is characterized by pyritization and alkali metasomatism, with albite and biotite being the most important hydrothermal mineral phases. Other alteration minerals include chlorite, white mica, and tourmaline. Studies conducted at the University of Western Australia (e.g. Dyer, 1991; Windh, 1992; Thornett, 1995) indicate that the ore fluids were of low to moderate salinity and H_2O–CO_2 rich.

Mineralization in the Bryah domain probably belongs to the epigenetic mesothermal lode-gold type. This type of mineralization is common within Proterozoic and Phanerozoic metamorphic terranes, is syn- to post-peak metamorphism, and correlates with episodes of accretion and collision tectonics (Kerrich and Cassidy, 1994).

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