

Pillow lavas in the Peak Hill and Glengarry terranes

by F. Pirajno, S. Occhipinti, G. Le Blanc Smith, and N. Adamides

Abstract

Pillow lavas occur in the Peak Hill and Glengarry tectonostratigraphic terranes (previously known as the Glengarry Basin). The lavas in the Peak Hill terrane have been deformed and metamorphosed to greenschist facies. Deformation and metamorphism may have been responsible for the channelling of fluids along shear zones. Gold mineralization is spatially associated with these shear zones. The pillow lavas in the Glengarry terrane underlie a sequence of black shales, are undeformed, and unmetamorphosed.

KEYWORDS: terrane analysis, pillow lavas, metamorphism, gold.

This is a preliminary report on the occurrence of basaltic pillow lavas in the southern areas of the Peak Hill and Glengarry tectonostratigraphic terranes (Fig. 1) of probable Early Proterozoic age. These terranes are part of what was previously known as the Glengarry Basin, which occupies the western portion of the Napperu Province, on the northern margin of the Archaean Yilgarn Craton (Capricorn Orogen; Fig. 1). The structural and tectonic evolution of the Glengarry Basin has been previously studied by Windh (1992) and Gee and Grey (1993).

Field observations integrated with photogeological and satellite-imagery interpretations suggest that the area known as the Glengarry Basin was formed by the amalgamation of at least three distinct tectonostratigraphic terranes. They are here provisionally named the Peak Hill and Glengarry terranes and the Border domain. A tentative and simplified geotectonic overview of the area is shown in Figure 1.

The Peak Hill terrane includes mafic-ultramafic volcanic rocks, and clastic and chemical sedimentary rocks that have been intensely deformed and metamorphosed up to middle greenschist facies. The deformation and metamorphism of this terrane are linked to its collision with a rigid Archaean block (Narryer Complex). The genesis of the epigenetic gold deposits of the Peak Hill terrane may also be related to this collision event.

The Border domain marks a major tectonic discontinuity along which the Glengarry and Peak Hill terranes were juxtaposed. A sedimentary basin was formed along this tectonic boundary, which acted as a depocentre for mass-wasting sourced from the adjacent, uplifted terranes. Structurally controlled gold and copper mineralization is present in this terrane.

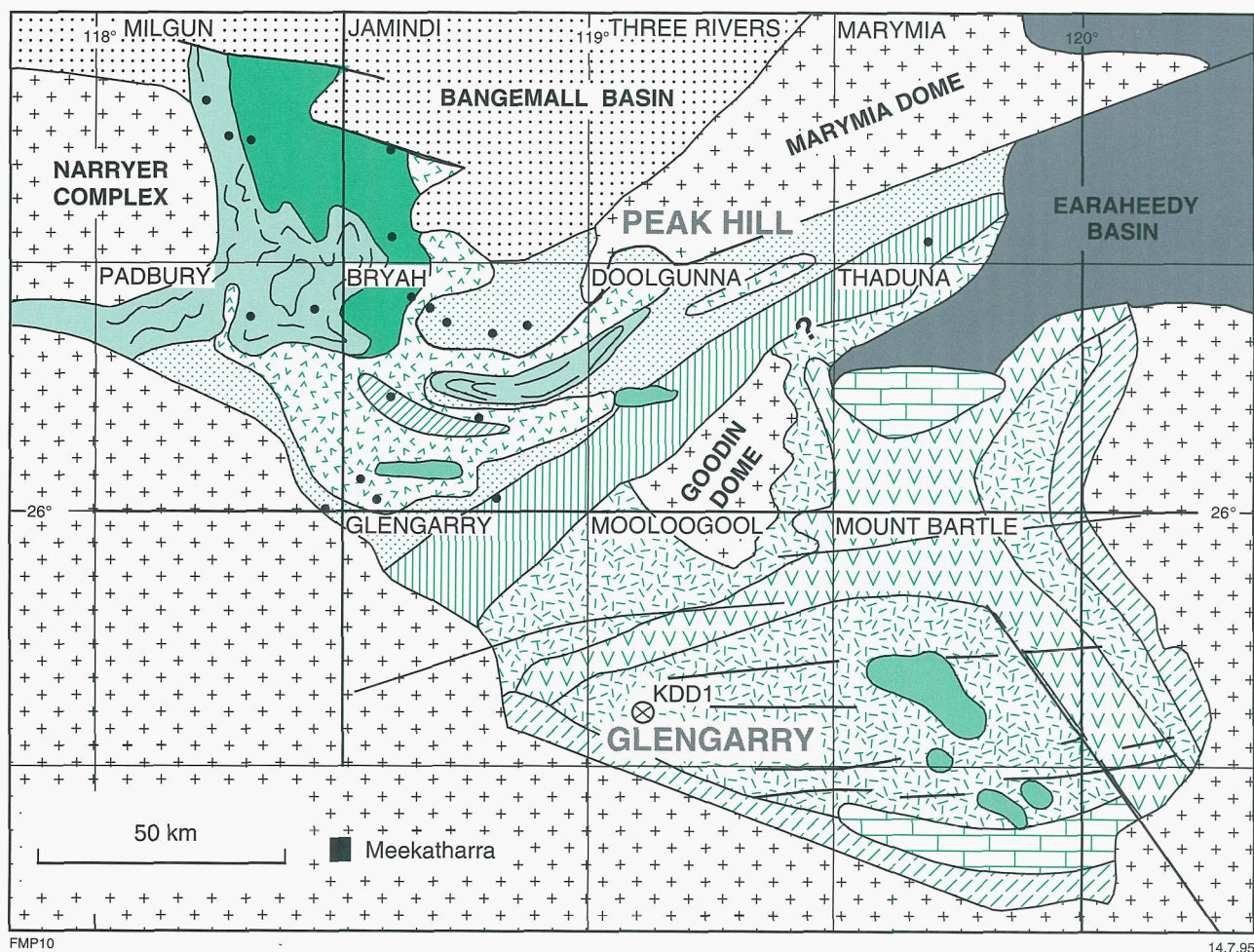
The Glengarry terrane is composed of a volcano-sedimentary sequence (Glengarry Group) deposited in an intracontinental-rift setting. Field work, integrated with core

examination from a number of drillholes, indicates that this terrane was formed during an extensional phase followed by a compressional phase. The former involved a phase of rifting, during which voluminous mafic intrusive and volcanic rocks were emplaced. This was followed by easterly trending listric faulting, with rotation and tilting of the strata towards the north. The compressional phase was characterized by re-activation of the listric faults, uplift, and mass-wasting with deposition of turbidites.

Mafic and ultramafic rocks on PEAK HILL* (1:250 000) have been grouped under the name Narracoota Volcanics (Gee, 1987). They have an estimated thickness of approximately 4000 m, occupy a mid-stratigraphic position in the Glengarry Group (Gee, 1987; Gee and Grey, 1993), and are thought to interfinger with volcanogenic clastic sediments (Thaduna Formation). A geochemical study of the Narracoota Volcanics by Hynes and Gee (1986) led to the conclusion that the volcanics have a general tholeiitic composition and may have originated in a continental-rift setting, although they appear to have a MORB-like signature.

In this paper we describe lavas from an arcuate belt of massive to pervasively deformed and sheared volcanic rocks in the southwest portion of PEAK HILL (Fig. 1). Pillow structures are common, and are recognizable even where they are deformed. We also report on the occurrence of a sequence of flat-lying, basaltic pillow lavas intersected at a depth of 400 m in a

* Capitalized names refer to standard map sheets.



PEAK HILL TERRANE

- Padbury Group
- Labouchere Group
- Clastics
- Naracoota Volcanics and associated sedimentary rocks
- Pillow lavas on BRYAH

BORDER DOMAIN

- Clastics mainly, and olistostromes

GLENGARRY TERRANE

- Turbidites
- Clastics and carbonate sequences
- Mafic volcanics (pillow lavas and sills and dykes?)
- Siliciclastics

- Epigenetic gold
- ⊗ Diamond drillhole
- Fault

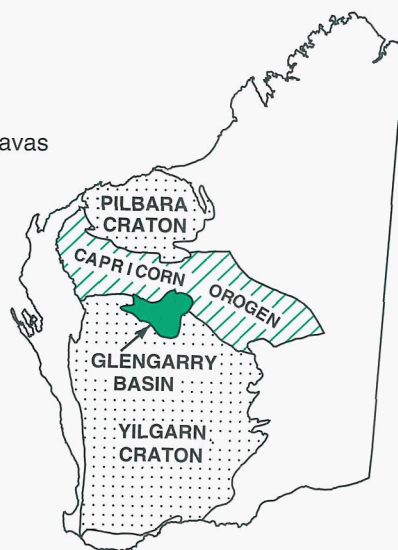


Figure 1. Simplified geotectonic and locality map of the Glengarry Basin showing the location of the 1:100 000 map sheets, the pillow lavas on BRYAH, and the drillhole on MOOLOOGOL. Inset shows the position of the basin within the Capricorn Orogen

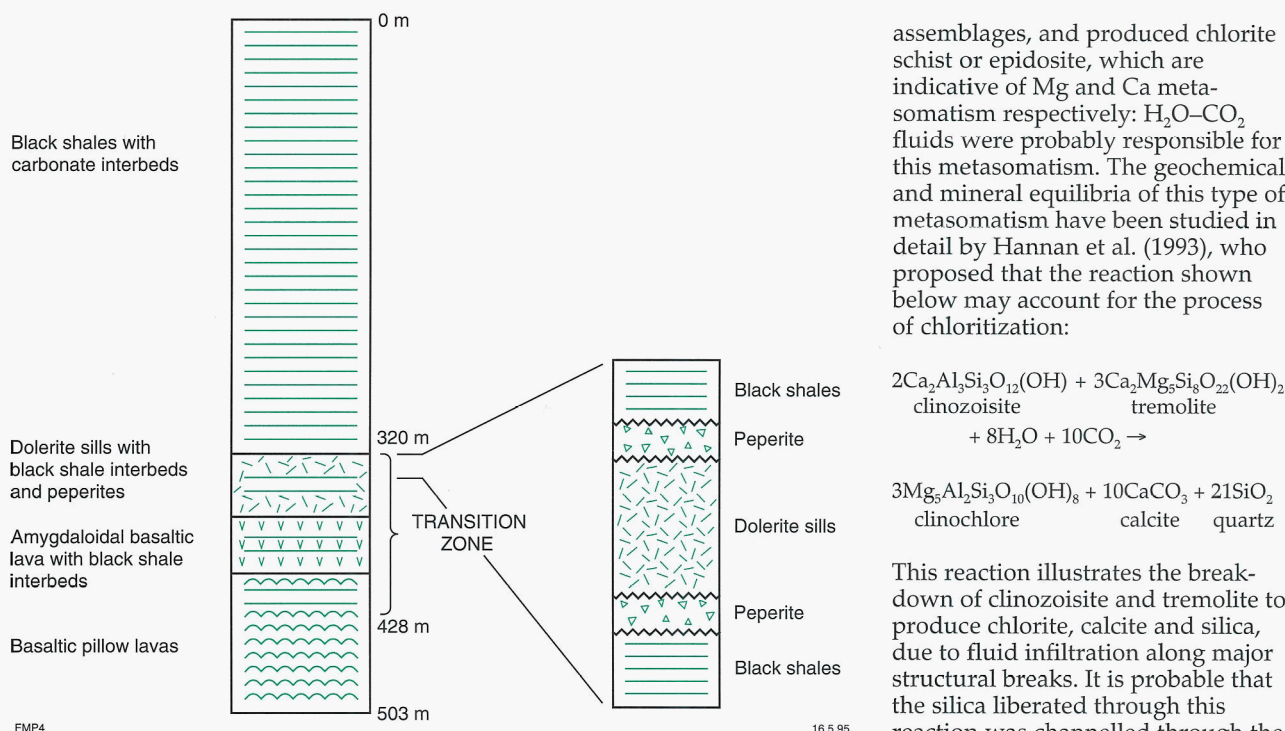


Figure 2. Idealized stratigraphy as deduced from drillhole KDD1. See text for details

diamond drillhole sunk by CRA Exploration in 1985 (Blomley and Cull, 1985). This drillhole is located 20 km east-southeast of the Killara Homestead, on GLENGARRY (1:250 000). The volcano-sedimentary sequence intersected by the drillhole belongs to the Glengarry terrane (Fig. 1).

BRYAH (1:100 000)

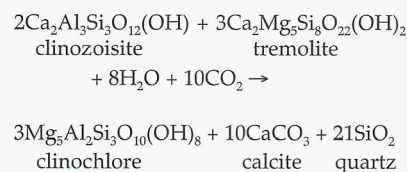
The pillow lavas and associated mafic-ultramafic schist occur in an arcuate belt in the southern part of BRYAH (on PEAK HILL 1:250 000) and are folded into an anticlinal structure (Gee, 1987). The presence of folding has been deduced from the younging directions of the pillows at a number of localities. Detailed geological mapping indicates that this belt of rocks is a major anastomosing shear domain, which contains pod-like outcrops of less-deformed pillow lavas. Dolerite sills have intruded the pillow lavas, and in the southwestern part of BRYAH the pillow lavas are associated with autoclastic and vent breccias.

The dominant schistosity within the shear zone dips steeply towards the

north and south, and strikes approximately east to west. A mineral lineation, defined by aligned chlorite porphyroblasts, has a shallow to moderate plunge towards the east. This indicates that maximum extension during deformation was in an approximately easterly trending direction. Quartz veins within the shear domain also trend approximately east to west. The major deformation event that affected the pillow lavas was probably D_2 , based on overprinting relations in the Robinson Range Syncline. Field observations suggest a left-lateral shear sense.

Massive to weakly deformed mafic volcanic rocks are fine- to medium-grained, with a regional metamorphic assemblage of tremolite-actinolite, albite, clinozoisite, chlorite, titanite, calcite, and quartz. The original igneous components of the rocks have been totally replaced by these minerals during regional greenschist-facies metamorphism. Within the shear domain, metasomatism of greenschist metamorphic assemblages accompanied pervasive deformation. This metasomatism resulted, in some cases, in chlorite- or epidote-dominated

assemblages, and produced chlorite schist or epidosite, which are indicative of Mg and Ca metasomatism respectively: $\text{H}_2\text{O}-\text{CO}_2$ fluids were probably responsible for this metasomatism. The geochemical and mineral equilibria of this type of metasomatism have been studied in detail by Hannan et al. (1993), who proposed that the reaction shown below may account for the process of chloritization:



This reaction illustrates the breakdown of clinozoisite and tremolite to produce chlorite, calcite and silica, due to fluid infiltration along major structural breaks. It is probable that the silica liberated through this reaction was channelled through the shear zone, resulting in zones of extensive silicification and/or quartz veins.

MOOLOOGOO (1:100 000)

Undeformed and unmetamorphosed pillow lavas occur in the southeastern part of MOOLOOGOO (1:100 000), and underlie a sequence of black shales approximately 320 m thick. This volcano-sedimentary sequence was intersected by exploration drilling (diamond drillhole KDD1 at latitude $26^\circ 24' 30''\text{S}$, longitude $119^\circ 08' 30''\text{E}$; Bromley and Cull, 1985; Figs 1 and 2). Between the black shales and the pillow lavas a transition zone, approximately 108 m thick, marks the transition from volcanism to sedimentation. This zone is characterized by intercalated thin beds of black shale, and doleritic sills and amygdaloidal basaltic lavas (Fig. 2). Peperite margins in the contact zones between the igneous material and the sedimentary rocks suggest that the mafic melts intruded wet and unconsolidated sediments. A continuous sequence of basaltic pillow lavas intersected by KDD1 occurs below 428 m from the top of the drillhole (Fig. 2).

The pillow lavas and the overlying shales are thought to have been deposited in a developing rift. They are associated with cogenetic mafic

sills and are part of a thick, little-deformed and unmetamorphosed volcano-sedimentary sequence in the Glengarry terrane (Fig. 1).

Conclusions

The pillow lavas in the Peak Hill and Glengarry terranes indicate the occurrence of subaqueous volcanism, possibly related to incipient phases of rifting. This is supported by the work of Hynes and Gee (1986) who concluded that the Narracoota Volcanics are tholeiitic in composition and were erupted in a continental-rift setting.

The Wembley and Heines Find gold deposits on BRYAH are hosted in discrete shear zones within the arcuate shear domain. It is possible that the mineralization is related to the movement of fluids along these structural breaks. Detailed studies are needed to characterize the nature of the pillow lavas, their significance in terms of the geodynamic evolution of the Peak Hill and Glengarry terranes, and their possible role in ore genesis.

Acknowledgements

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