SHRIMP U - Pb ZIRCON DATING OF ARCHAEAN GREENSTONE SEQUENCES FROM THE EASTERN GOLDFIELDS , WESTERN AUSTRALIA

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Detailed mapping by the GSWA in the Eastern Goldfields Province of the Archaean Yilgarn Craton has delineated a series of fault-bounded tectonostratigraphic terranes. The westernmost Kalgoorlie Terrane consists of ultramafic and mafic flows and felsic volcaniclastics with relatively simple and coherent regional stratigraphy. The eastern terranes have diverse and complex stratigraphic sequences comprised predominantly of laterally discontinuous basaltic and ultramafic units and proximal volcaniclastic units. High-precision U - Pb zircon dating using the recently-commissioned Perth SHRIMP indicates that felsic volcaniclastic rocks within the Kalgoorlie and eastern terranes were deposited contemporaneously at 2683 ±5 Ma. Similar emplacement ages of 2690 - 2680 Ma have been reported for early (pre-D2) granitoids (e.g. Hill et al. 1992). Geochemical and isotopic data indicate that the early granitoids and felsic volcanics were derived from similar sources and may have been cogenetic. Multiply-deformed monzogranite- to granodiorite gneisses are exposed at localities near the western, southern and eastern margins of the Eastern Goldfields Province greenstones. These gneisses typically preserve upper amphibolite facies mineral assemblages, are characterised by low zircon abundances, complex zircon age populations and contain zircons as old as c. 3300 Ma. Fragments of similar gneisses probably formed part of the basement to the greenstones and provided the source rocks from which the granites and felsic volcanics were derived.

The following evolutionary model of the formation of the Eastern Goldfields granite-greenstone terranes is consistent with the available field and geochronological constraints. At c. 2710 - 2690 Ma, asymmetric rifting, mainly by N - S-trending normal faulting, of pre-existing granitic and gneissic crust resulted in the development of a series of adjacent shallow basins, into which predominantly basaltic and ultramafic volcanics were deposited. At c. 2685 Ma, felsic volcaniclastic rocks were erupted from numerous volcanic centres and early (pre-D2) granitoids were emplaced mainly as thick sheets into the base of the greenstone sequences. This igneous activity may have been a consequence of heating of the base of the crust during crustal thinning. This was followed at c. 2675 - 2665 Ma by regional (D2) compression involving reactivation of early structures. Additional episodes of granitoid emplacement have been identified at c. 2665 - 2660 Ma and c. 2630 - 2600 Ma (Hill et al. 1992).

Tectonic models advocating the involvement of mantle plumes (e.g. Hill et al. 1992) cannot account for the compressional regime responsible for D2 structures and the volcanic rocks lack many of the diagnostic geochemical features found in the volcanic rocks of modern subduction zones. An active continental margin back-arc basin setting offers the closest modern analogous tectonic setting.

Hill R.I., Chappell B.W., and Campbell I.H., 1992, Late Archaean granites of the southeast Yilgarn Block, Western Australia: age, geochemistry, and origin: Trans. R. Soc. Edinburgh: Earth Sciences, v. 83, p. 211-226.