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Tectonic Model for Lachlan Fold Belt I-, S- and A-Type Granites

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I- and S-type granites were originally classified in the Lachlan Fold Belt in SE Australia (Chappell and White, 1974). Later, the petrogenesis of A-type granites was also discussed using the Lachlan as the type example (Collins et al., 1982). However, subsequent studies have shown that the S-I, A-type classification is not easily applicable to typical active continental margins like those of North and South America. Nonetheless, the classification is applicable to granites from South East Asia. In a review of the relationships between granites and geodynamic environment, Barbarin (1999) inferred that I-types (his ACG) form in subduction settings, S-types (his CPG) form in collision settings, and A-types (his PAG) form in continental rift settings. However, in the Lachlan, I- and S-type overlap in time and space, and I- and A-type overlap in time and space, so they must form in the same geodynamic environment. What is it?In an attempt to resolve the Lachlan tectonic setting, I have investigated the geochemistry of >600 mafic rocks from the Ordovician, Silurian and Devonian periods. Ordovician mafic volcanics have extremely primitive mantle isotopic signature and their geochemical patterns are typical of an intra-oceanic arc, consistent with the lack of silicic granitoids during this period. Widespread silicic magmatism occurred in the Early-Mid Silurian (435-420 Ma), when most of the S-type granites and few I-types formed. Basalts associated with these granites range from oceanic arc to oceanic backarc. Following development of a widespread end-Silurian unconformity associated with weak compression, I-type intruded extensively across the Laclan during the Early Devonian (420-395 Ma). Associated Early Devonian basalts typically show arc to interarc rift character, very similar to the Neogene Taupo Volcanic Zone basalts of New Zealand. Lachlan A-type granites mostly formed in the Middle to Late Devonian, associated with minor I-type magmatism. The associated basaltic rocks are transitional between calc-alkaline and alkaline, and closely resemble those of the Basin and Range of western USA. The common tectonic feature of all periods of granite emplacement is the extensional setting recorded by the basalts. Oceanic arc to backarc type basalts associated with S-types shows they did not form in a continental collision setting. Indeed, the Early-mid Silurian was a time when deep-water, sediment-filled troughs were forming during crustal extension in the Lachlan. During I-type magmatism in the Early Devonian, a large turbiditic basin called the Hill End Trough formed and partly filled with I-type volcanics. It has the sedimentological and stratigraphic character of the Lau Basin, a backarc basin located just north of New Zealand, which suggests the Lachlan I-type granites formed in an arc-rift to backarc environment, again

associated with crustal extension. Lastly, the A-types were associated with bimodal volcanics and continental redbeds, suggestive of a continental rift environment. In conclusion, the Lachlan underwent a series long-lived extensional events, which were probably associated with ongoing subducton rollback, during which time, S-, I- and A-type granites were generated and emplaced. References Barbarin B.1998. Lithos 46, 605-626. Chappell, B. W. and White, A. J. R., 1974. Pacific Geology 8, 173-174. Collins, W. J. et al., 1982. Contributions to Mineralogy Petrology 80, 189-200.