500 million years of episodic anorthosite/leucogabbro – granodiorite/monzogranite (ALG) magmatism in the Archean Yilgarn craton

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The Narryer Gneiss Complex (NGC) of Western Australia is one of largest intact blocks of early-middle Archean rocks (3.7–3.2 Ga) preserved on Earth. New laser ablation-inductively coupled plasma-mass spectrometer (LA-ICP-MS) U-Pb zircon geochronology and whole rock geochemistry of twenty-five NGC orthogneisses suggest that the terrane formed largely from episodic, bimodal

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anorthosite/leucogabbro–granodiorite/monzogranite (ALG) magmatism. Trondhjemite-tonalite-granodiorite (TTG) and dioritic magmatism, common in many Archean terranes elsewhere, is rare in the NGC. ALG suites represent a newly-defined, distinctive magmatic association for the Archean, similar in some respects to Mesoproterozoic Anorthosite-Mangerite-Charnockite-(Rapakivi) Granite (AMCG) suites.

The gneiss samples were collected from north of the Jack Hills and northwest of Mount Dugel. LA-ICP-MS U-Pb zircon ages cluster at 3720 Ma, 3680 Ma, 3620 Ma, 3490 Ma, 3320 Ma, and 3260 Ma. Each of the age populations includes granodiorite/monzogranite gneisses, and all except the two youngest populations consist of anorthosite/leucogabbro gneisses. The granite gneisses have remarkably similar bulk compositions, independent of age: they are all moderately peraluminous (alumina saturation indices of 1.05 to 1.1) potassic granodiorites and monzogranites, quite unlike their more well-known Archean, sodic TTG counterparts. Formation of the ALG magmatic association is not easily reconciled with convergent plate tectonic processes (subduction). Its existence suggests that a major mechanism of mantle heat loss before 3.2 Ga was by episodic, but long-lived, within-plate magmatism in intra-continental rifts or at hot spots.