TECTONOTHERMAL EVOLUTION OF WILLYAMA SUPERGROUP AND TIMING OF BASE-METAL MINERALISATION, BROKEN HILL, AUSTRALIA

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Structural analysis of the Palaeoproterozoic Willyama Supergroup, combined with new zircon U/Pb age data and thermobarometric calculations on mineral assemblages whose structural context is known, enable a detailed tectonothermal history of the Broken Hill region to be established for the first time. In contrast to earlier interpretations, peak metamorphism (M1) is considered to have been induced by extensional rather than compressional processes and probably occurred around 1690 Ma, some 100 Ma earlier than previously supposed. M1 metamorphism occurred under low P – high T amphibolite to granulite facies conditions, and was accompanied by widespread granite magmatism, mafic dyke emplacement and development of a pervasive layer-parallel schistosity. This event was followed by an episode of compressional tectonics (D2) leading to crustal thickening, higher pressure metamorphism (7-8 kbar; 700-800?C) and northeast-directed nappe formation. Associated mineral assemblages (M2) typically contain almandine garnet in addition to sillimanite, biotite and K-feldspar, and were subsequently overprinted by younger deformational fabrics (D3) and lower grade (M3) mineral assemblages (3-5 kbar; 480-550?C) containing garnet with higher spessartine contents. Spessartine garnet also occurs in the “Mn halo” around the Broken Hill Line of Lode, possibly indicating a genetic link between mineralisation and development of the regional D3 fabrics. The D3 deformation was thrust-related and produced crustal-scale southeast-dipping shear zones in which Pb-Zn-Ag mineralisation is locally developed. U/Pb dating of zircon from a spessartine-rich rock within the Broken Hill Line of Lode supports a 1590 Ma age for both the D3 deformation and its associated base-metal mineralisation.