Metallic-Pb Nanospheres in Archean Zircon from the Challenger Au Deposit, South Australia

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Metallic-Pb nanospheres (M-PbNs) are documented within zircon from Archean ultrahigh-temperature metamorphic terranes (UHT; [1,2]). Radiogenic Pb mobilized from radiation-damaged domains in zircon predating the metamorphic event is trapped as M-PbNs. Dating using nanoSIMS, shows the M-PbNs record the UHT event [3]. Here we report M-PbNs in zircon from Challenger, an Archean Au deposit, central Gawler Craton, South Australia. Bonanza ore from the sulfide-poor M1 orebody has been attributed to enrichment of low-Au protore via Au-Bi melts during ~2.4 Ga granulite facies metamorphism at peak conditions of 850 °C, 7 kbar [4]. Our study reports on zircon from sulfide-bearing, Au-Ag-Te ores (M2 orebody) recording a fluid-driven, 300-400 °C retrograde overprint.

Scanning transmission electron microscopy imaging of ~ 2.6 Ga zircon (Fig. 1A) reveals the presence of M-PbNs with Sc-bearing halos (Fig. 1B, C), and galena nanoparticles (NPs), in unaltered and altered domains, respectively. M-PbNs and Pb-Bi-Te-S-bearing NPs are identified within inherited Archean (~2.7 Ga) zircon with Sc-rich signature from the ~1.6 Ga volcanic-hosted, Fe-oxide Cu-Au prospect at Acropolis, Olympic Dam district, eastern Gawler Craton [5]. Preserved M-PbNs in zircon from various ore systems can be used, despite later interaction with hydrothermal fluids, to fingerprint inherited lithologies and trace element sources.

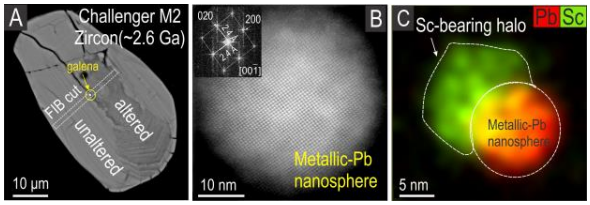

Fig. 1. Metallic Pb nanosphere, ~30 nm wide, in Challenger zircon.

[**1**] Kusiak et al. (2015) *PNAS*, **112**, 4958–4963;
[**2**] Whitehouse et al. (2017) *Mineral Petrol*, **111**, 467–474;
[**3**] Lyon et al. (2019) *Sci Reports*, **9**, 13702;
[**4**] Tomkins & Mavrogenes (2002) *Econ Geol*, **97**, 1249–1271;
[**5**] Courtney-Davies et al. (2020) Abstract, SEG Conf., Whistler.