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Early planetesimal accretion and magmatic records in achondrite meteorites

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Achondrite meteorites record the earliest evidence of volcanic activity in the Solar System. The ^{182}Hf-^{182}W records of non-carbonaceous (NC) iron meteorites provide model ages for core formation as early as 0.3 Myr after calcium-aluminium-rich inclusions (CAIs), supporting even earlier accretion times for their parent bodies [1]. Stony achondrite meteorites provide evidence of early melting of chondritic [2] or differentiated [3] sources. These planetesimals were predominantly heated by the decay of short-lived radionuclide ^{26}Al (half-life ~0.7 Myr), which was subsequently enriched in crustal reservoirs during partial melting. Large uncertainties remain for modelling the accretion timescales owing to complex histories of magmatic differentiation and secondary processes (e.g., metamorphism, metasomatism, impact).

The oldest known lava is an andesitic meteorite Erg Chech 002, which crystallized within ~2 Myr from CAIs [2, 4, 5]. Using its chronological records, we model a best-fit planetesimal with a radius of 20-30 km that formed at ~0.1 Myr after CAIs [6]. Angrites are sub-grouped either fine-grained volcanic angrites (formed 3-4 Myr after CAIs) or coarse-grained plutonic angrites (~10 Myr after CAIs). We obtained petrological and thermochronological records using U-Pb dating of mineral separates for an olivine-bearing plutonic angrite NWA 10463 [7] and of phosphates for NWA 10463 and the unique angritic dunite Northwest Africa (NWA) 8535. Phosphate SIMS U-Pb ages range from 4552±5 Myr to 4512±18 Myr (2s). In the absence of evidence of shock effects, such extended heating within the crust supports a relatively larger angrite parent body [8].

[1] Kruijer T. S. et al. (2020) *Nature Astronomy* 4, 32–40. [2] Barrat J.-A. et al. (2021) *Proceedings of the National Academy of Sciences* 118, e2026129118. [3] Frossard P. et al. (2019) *Geochemical Perspective Letters* 11, 28–32. [4] Fang L. et al. (2022) *Proceedings of the National Academy of Sciences* 119, e2120933119. [5] Reger P. M. et al. (2023) *Geochimica et Cosmochimica Acta* 343, 33-48. [6] Neumann W. et al. (2023) *The Planetary Science Journal*, doi.org/10.48550/arXiv.42302.12753. [7] Reger P. M. et al. (2021) *84th Annual Meeting of the Meteoritical Society* 84, 6235. [8] Tissot F. L. et al. (2022) *Geochimica et Cosmochimica Acta*, 338, 278-301.