

LYNCH 002: A NEW LUNAR METEORITE FROM THE NULLARBOR DESERT, WESTERN AUSTRALIA

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Introduction: Lynch 002 is a new lunar meteorite, weighing 36.5 g, found during systematic open plain searching in the Nullarbor Desert of Western Australia in September 2010. Despite hundreds of meteorites being recovered from this region, Lynch 002 is only the second lunar meteorite to be found on the Australian continent – the other being Calalong Creek [1].

Petrography and Mineralogy: Lynch 002 displays a complex, highly brecciated texture and is polymict, containing a diverse array of lithic and single mineral clasts, glass spherules, agglutinates, and melt both as cross-cutting veins, and cement to the fine matrix. *Clasts:* Mare basalt and finely crystalline feldspathic impact melt breccia fragments form the largest clasts, up to ~ 1 mm in size. KREEP-rich clasts (with intergrown skeletal K-feldspar, silica and micrometer-scale REE-Y-Zr-rich phases), and pyroxferroite remnants (hedenbergite, fayalite and silica) are also abundant, as are grains of high and low-Ca pyroxene, typically of 200 micrometers size. *Spherules:* Glassy spherules up to ~150 micrometers in diameter show Na-rich (1 % wt) and Na-poor compositions. *Matrix:* the finer indurated matrix is composed primarily of plagioclase and high and low-Ca pyroxene. As well as individual mineral grains, polymineralic grains or small clasts up to a few tens of micrometers are also common. These small clasts are very similar to the population of larger clasts and presumably represent smaller fragments derived from the same or similar sources. Fe-Ti oxide grains are fairly abundant, and baddeleyite and silica are also found. Irregular Fe-Ni metal grains are fairly abundant, most are only a few micrometers in size, although some reach a few tens of micrometers. *Melt veins:* Melt veins are pervasive and range in width from a few micrometers to irregular patches almost 1mm across. The coarser melt veins are vesicular for much of their length, partially fill open fracture voids, and contain small blebs of Fe-Ni metal. Many of the veins show complex cross-cutting relationships between surrounding material, and with other melt veins. *Oxygen isotopes:* Replicate analyses were carried out on an acid washed, bulk sample (all values in per mil); $\delta^{17}\text{O} = 3.638, 3.470$ $\delta^{18}\text{O} = 7.005, 6.676$ $\Delta^{17}\text{O} = -0.005, -0.002$.

The sample is moderately to highly weathered with a dark brown/black desert varnish crust of up to 125 micrometers thickness. No fusion crust remains. Cracks and fissures are widespread; many are filled with Ca carbonate.

Conclusion: Lynch 002 is a highly brecciated meteorite containing diverse lunar lithologies and mineral phases, reflecting a wide range of igneous activity and multiple phases of impact and regolith processing.

[1] Meteoritical Bulletin Database.
<http://www.lpi.usra.edu/meteor/metbull.php>