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Cosmic Dust as a Carrier of Natural Remanent Magnetisation? A Case Study from the Jurassic Stromatolites from the Zalas Quarry, Krakow Upland, Poland

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A b s t r a c t

A paleomagnetic study of a Middle/Upper Jurassic stromatolite section from the Zalas quarry was conducted and revealed a well-defined structure of natural remanent magnetisation (NRM) comprising: (1) a viscous component (20–100°C), (2) a normal secondary component (100–275°C), and (3) normal and reversed primary components (275–500°C) (Fig. 1A). Scanning electron microscopy (SEM) studies of magnetic extracts revealed that the vast majority of the recovered magnetic mineral fraction consists of spherulitic iron-nickel grains of 10 to 300 μm in diameter. These spherules are identified as micrometeorites. We present a comprehensive rock magnetic and microscopy study of the micrometeorites and discuss their potential as NRM recorders.

A suite of over 50 individual micrometeorites within the 100–200μm grain size range were selected for the study. FORC diagrams show a "wishbone" signature characteristic of strong magnetostatic interactions between grains in the stable SD grain-size threshold (Fig. 2A). A SEM study of the micrometeorites reveals a highly complex internal structure (Figs. 2B, 3) of closely packed iron-containing grains which may explain the source of the strong interaction features observed in the FORC diagrams. These grains display high intra- and inter-sample variability. Despite the textural complexity and non-trivial magnetic properties of the micrometeorites they are potentially stable paleomagnetic remanence carriers.

FORC diagrams of bulk stromatolite samples show a low coercivity "central-ridge" SD signature. The source of this SD carrier remains largely unknown with magnetotactic bacteria being a likely explanation. Further examination of the magnetic extracts is required to conclusively determine the main source of the bulk rock magnetisation.

Keywords: micrometeorites, stromatolite, NRM carriers, FORC.

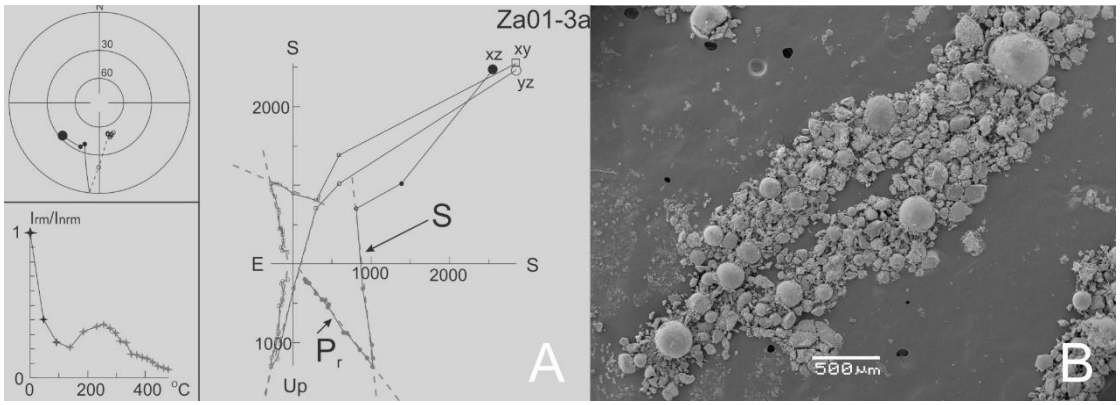

Fig. 1: A) Thermal demagnetisation results of the stromatolite sample. S – secondary component of NRM, Pr – primary (reversed) component of NRM; B) Ferromagnetic grains separated from the Zalas stromatolite.

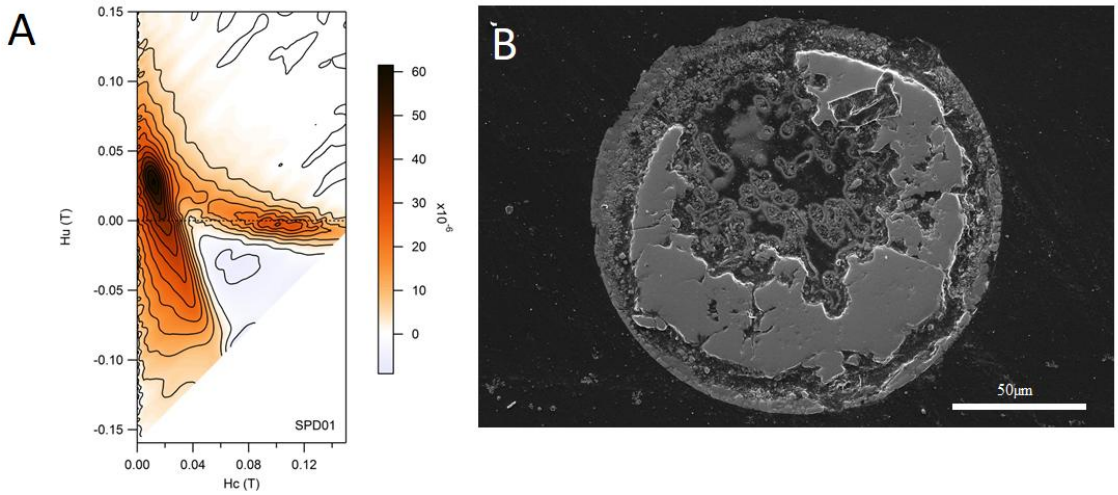

Fig. 2: A) Wishbone FORC diagram measured on an individual micrometeorite; B) secondary electron image of cross-section of micrometeorite.

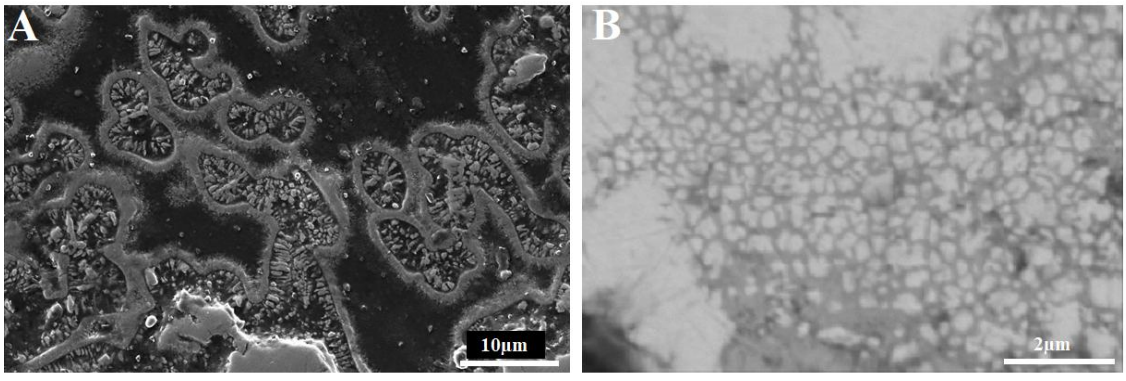

Fig. 3: A) Secondary electron; and B) backscatter electron image examples of internal textural features in two individual micrometeorites.