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Collision and Thermal Histories of Solar System Bodies Derived using the $^{40}Ar/^{39}Ar$ Dating Method

SIMON PETER KELLEY

University of Leeds

Grenville Turner made pioneering contributions to our understanding of the collision and thermal history of solar system bodies. His earliest work, including co-developing the $^{40}Ar/^{39}Ar$ dating technique and the 'step heating' method, derived thermal histories from very small meteorite samples, laying the groundwork for a huge body of subsequent research. Grenville was also one of the earliest adopters of focussed laser extraction which he saw as enabling spot dating and miniaturised step heating, linking ages to individual minerals and textures in meteorites and Moon rocks.

Grenville's early $^{40}Ar/^{39}Ar$ studies, step heating lunar samples returned by the NASA Apollo missions, shed light on the bombardment history of the Moon and lunar bombardment history has been an area of almost constant study ever since. Grenville's early work continues to excite new science and vigorous scientific debate.

A brief series of $^{40}Ar/^{39}Ar$ case studies illustrates how the combination of laser spot ages and step heating have characterised solar system collisional events. In fact, one of the earliest combinations of $^{40}Ar/^{39}Ar$ step heating and laser extraction was by Grenville's group, analysing the Peace River L6 Chondrite revealing a collision age of 450±30 Ma and it's subsequent thermal history. The study also provided an insight into the dissolution of argon into melt during shock heating events caused by collisions.

Combining laser spot dating and step heating has proved particularly effective in unravelling complex samples such as the Bencubbin breccia meteorite. This is illustrated by recent analysis of an HED meteorite using UV laser extraction demonstrating how the high spatial resolution capabilities can resolve a complex collision and thermal history.

In summary, we continue to learn more about the solar systems collision history thanks to Grenville's pioneering work, helping us understand why meteorites cross and occasionally hit the Earth.