Laser Raman spectra of Bedout ‘maskelynite’: comparison with shocked plagioclases from Martian meteorite (SaU 005) and the Lonar impact crater, and synthetic albite (CIT# 1424) and anorthite (CIT# 1301). A. R. Basu, R. Chakrabarti, J. Peterson, R. J. Poreda, L. Becker

We report a detailed laser Raman spectroscopic study of optically isotropic plagioclase laths (~An50) from the 9986 ft. core sample of the Bedout High, interpreted recently by Becker et al (2004) as the possible remnant of an end-Permian impact crater offshore of NW Australia. These plagioclase laths are associated with spherulitic glass fragments of nearly pure silica composition, pure albite as well as other heterogeneous glassy fragments in a highly brecciated volcanic-like host rock. We performed multiple sets of Raman measurements on the same grains shown in Figure 6 of Becker et al. (2004) and interpreted as “maskelynite”. The results are shown here along with a comparison of Raman measurements on additional samples of shocked plagioclase from a Martian meteorite, synthetic albite and anorthite glass and another terrestrial maskelynite sample from the Lonar impact crater in India (See also Chakrabarti et al. 2006).

Raman scattering measurements were performed using the 514.5 nm line of an argon ion laser at an intensity of 40 kW/cm². An inverted microscope (Nikon TE300) with 50x objective (NA 0.55) was used for confocal imaging. A holographic notch filter removed residual laser scatter and the Raman scattering was detected by a silicon CCD at –90°C (Princeton Instruments Spec 10-400R). The Raman spectra (Relative Intensity in AU versus Raman shift in cm⁻¹) are shown in Figs 1-3.

Raman spectra were collected from ~250 cm⁻¹ through 2000 cm⁻¹ in all these samples. An optically anisotropic plagioclase grain from the same 9986 polished thin section shows prominent peaks at 827 cm⁻¹, 1109 cm⁻¹ and 1180 cm⁻¹ with much smaller peaks at 433 cm⁻¹ and 634 cm⁻¹ (Fig.1a). The Raman spectra of the isotropic grains in slide 9986 were conspicuously featureless and show a progressive increase in the luminescent background with higher wave numbers (Fig.1b). This observation is consistent with the Raman spectra of experimentally shocked plagioclase (Heymann and Horz, 1990) as well as those of natural, impact-induced, shocked plagioclase (Fig.1c) from the Lonar impact crater (Chakrabarti et al., 2006).

To investigate further why these above samples characteristically showed increasing luminosity with higher wave numbers, we analyzed the Raman spectra of a wider variety of naturally shocked plagioclase samples from Martian as well as terrestrial samples and compared them with the Bedout “maskelynite” spectra by using the 632.8 nm line of a He-Ne laser. In the acquisition of these new spectra we used the identical instrument setup as with the 514.5 nm Ar-ion laser. The purpose of the longer wave length and hence lower energy laser was to investigate if indeed the luminosity increase was due to the higher energy and if the increased luminosity masked any peak of the Bedout “maskelynite”. The results of our new Raman measurements are shown in Fig. 2 that includes the Bedout maskelynite sample (Fig 2a), compared with partially shocked plagioclase of the Martian meteorite, SaU 005 (Fig. 2b), Lonar crater maskelynite (Fig 2c), as well as synthetic plagioclase glass samples of albite (Fig 2d) and anorthite (Fig 2e).

It is clear from the Raman spectra of Fig.2 a, b and c of the 632.8 nm line that they are similar but are different from those obtained with the 514.5 nm Ar-ion laser (Fig.1a). Most importantly, they do not show progressively higher intensity with increasing wave numbers, as in Fig. 1a and b. Instead these spectra are featureless without characteristic discernible peaks, except for a broad hump between ~450 and 600 cm⁻¹ wave numbers (Fig.2a, b, c). The spectra of the synthetic plagioclase glass samples, albite and anorthite (Fig. 2d, e), interestingly, are also similar to the above mentioned shocked plagioclase samples in Bedout, Lonar and the Martian meteorite. In Fig. 3a and b the Raman spectra taken with the 632.8 nm laser of the glass of the glass slide and the epoxy holding the samples to the slides are shown. Both the epoxy and the glass slide show characteristic and independent signatures in their Raman spectra, distinctly different from the shocked and glassy plagioclase samples, the focus of this study.

The similarity of the Raman spectra of the Bedout “maskelynite”, the Lonar crater maskelynite, and the “shocked plagioclases” of the Martian meteorite is an important finding of our study. This similarity suggests that all these above samples possibly reflect their origin as dense, highly disordered, quenched glass. Some naturally shocked plagioclase may represent diaplectic plagioclase glass formed by solidstate transformation (see Chakrabarti et al., 2006).