EVIDENCE FOR A LIGHTNING-STRIKE ORIGIN OF THE EDEOWIE GLASS F. A. Macdonald[1], K. Mitchell[2], S. E. Cina[1], [1]Division of Geological and Planetary Sciences, Mail Code 170-25, California Institute of Technology, Pasadena, CA 91125, USA, francis@gps.caltech.edu, [2]81 Fern St., Gerringong, NSW 2534, Australia

Introduction: We report radiating tubular forms in the Edeowie glass and associated baked sediments that are characteristic of lightning-strike fusion. Along with the tubular morphologies, the Edeowie Glass is commonly highly vesicular or in sheet-like forms. These melts are typically found together with baked sandy clays that are tens of centimeters thick and similar in appearance to fired bricks.

The Edeowie glass was first described by Haines et al. (1) as a possible impact melt on the basis of Planar Deformation Features (PDFs) in quartz grains that were imbedded within the vesicular melts, and the presence of lechatelierite. However, the morphology and distribution of the glasses are inconsistent with an impact origin. The presumed PDFs are probably planar cracking, and lechatelierite, baddeleyite, and perhaps even coesite and schtishovite can occur in fulgurites.

Field Observations: The Edeowie glass is located in a semi-continuous swath extending at least 55 X 10 km along the western side of the Flinders Ranges, approximately 10 km from the face of the range. The glasses are associated with discrete raised, resistant outcrops of baked sediments that are situated on reexhumed playa surfaces. The baked sediment is not a continuous layer, but rather, it occurs in discrete pods. Where in place, the vesicular glasses are in contact with black baked sediment that appears to be a transitional form between the melt and the brick red baked sediment. Melt was found that is over 2 m long and in situ, and in places, the vesicular melt is tens of centimeters thick. The largest outcrop of baked sediment that was observed was 2 X 3.5 m. Similar slaggy, large fulgurites have been reported in soils in Michigan (2) and Western Australia (3).

Tubular forms are very common in the baked sediments, and occur occasionally in the glasses. Tubes range in diameter from 30 cm to less than a centimeter. Tubes within the baked sediment occasionally harbor vesicular melt around the fringes, particularly at the end openings of the tubes. Glassy surfaces on tubes and in the sheet form can take on a porcelain-like sheen, and vary in color from white to black to yellow and red.

As the planar features are restricted to quartz grains in the highly vesicular forms that are often found on the flanks of tubes, and the baked sediment is thinner under the sheet melts, it appears that the initial strikes occurred where the thick baked sediment is preserved, and the melt sheets occur where the lightning spread on the surface, radiating from sub horizontal tubes on conductive surfaces. Haines et al. (1) recognized circular hollows in the baked surfaces but attributed them to former tree trunks. We find this explanation unlikely, as tube forms within the sediments often increase in size outwards and a layer of vesicular melt occasionally lines the tube walls. Haines et al. [1] also claimed that the vesicular forms are more common at the northern locality and the slag like forms are more common at the southern locality. We found this not to be the case, but rather, there were no systematic variations in melt type or thickness across the 55 X 10 km area that we studied, but rather, a consistent association of melts with discrete pods of baked sediment that often harbored tubular forms.

High P/T Features: Planar features in quartz grains and lechatelierite are present in the Edeowie Glass. Karfunkel et al. (6) found that quartz buried in colluvium, which is hit by lightning, can pass the a-b quartz transition, producing temperatures in excess of 1470°C, and damaging quartz grains. As cristobalite has a pronounced planar fracture cleavage parallel to the rhombohedral r and z faces, cracks can form an X-pattern, similar to PDFs (6). Coesite has also been found in fulgurites (6,7), suggesting that the transient pressures in a lightening strike may also be capable of creating PDFs in quartz. Moreover, Essene (2) found phases in fulgurites that form at temperatures excess of 1800°C, indicating that lightning strikes can produce both lechatelierite and baddeleyite.

Age and Paleomagnetism: Paleomagnetic measurements, using thermal demagnetization techniques, on over 15 samples of Edeowie Glass all yielded a normal polarity, whereas the Australites were deposited during a reversed magnetochron, eliminating the possibility that the two glasses were created in the same event. The excellent preservation of the glasses in both active and reexhumed playas indicates that they were created recently and certainly during the past 0.76 Ma.

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