RAMAN DETECTION OF TITANIA-II, AN IMPACT INDUCED RUTILE POLYMORPH IN SUEVITE EJECTA AT BOSUMPTWI CRATER, GHANA John. F. McHone[1], Marc. D. Fries[2], and Marvin Killgore[3]. [1]Arizona State University <jmchone@hotmail.com>, [2]Jet Propulsion Laboratory <Marc.D.Fries@jpl.nasa.gov>, [3]University of Arizona <killgore@lpl.arizona.edu>.

An impact origin for Bosumtwi crater gained firm support in 1962 as USGS workers in Washington DC reported both lechatelierite and coesite in samples supplied by the Geological Survey of Ghana [1]. Encouraged by these results, additional samples from near the north crater rim were retrieved that same year by pioneer impact scientist Robert Dietz. As techniques and methods for detecting impact criteria evolved over intervening years, his collection of suevite-like rocks have been examined repeatedly. Using microbeam Raman spectroscopy, titanium dioxide II, a presently unnamed pressure polymorph of rutile, has now been identified in an archived laboratory sample [2].

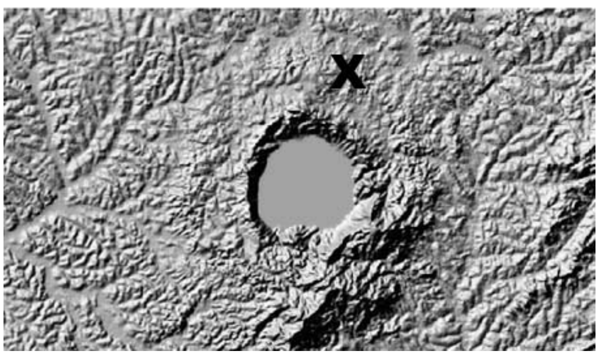

Figure 1. Shuttle Radar Topographic Mission (SRTM) image of 8.5 km wide Lake Bosumtwi. X marks approximate suevite location.

During the late 1980's rumors of stishovite in diamond-bearing gravels of southern Ghana circulated among skilled mineralogists [3]. Stishovite is widely regarded as a reliable impact-shock indicator, and splits of Dietz samples were subjected to a (mostly destructive) search process. Whole rocks were crushed, partially dissolved in acids, and finally examined with powder X-Ray diffraction. XRD patterns revealed possible weak, but not conclusive, stishovite peaks; the samples were mostly quartz, rutile, zircon, and graphite. Residual materials were therefore returned to storage.

By the early 2000's the rapidly developing field of Raman Spectroscopy had matured to a useful technique for identifying minute mineral grains. An archived residual powder sample was retrieved and granular splits were examined with a microbeam Raman instrument at Carnegie Institute of Washington's Geophysical Lab. As with earlier XRD results, most grains were composed of quartz, rutile, zircon, and graphite. However, under an optical microscope, many subrounded rutile granules 5 – 12 nm across appeared as aggregates with small, brighter grains adhered to their surface. Larger host masses produced a rutile Raman spectrum with strong bands at wave numbers 440 and 605 cm^{-1}, but the smaller small parasitic grains produced several Raman bands including 172, 284, 313, 341, 356, and 426 cm^{-1} See Figures 2 and 3. This Raman pattern is distinct to a shock metamorphosed polymorph of rutile [4], the orthorhombic alpha Pb02-structured phase of Titanium dioxide (TiO2-II).

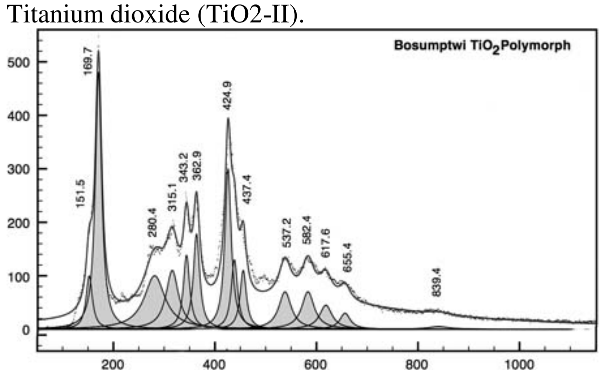

Figure 2. Processed Raman data from one of several submicron TiO2-II particles aggregated with a single 9 micron rutile grain. Gauss/Laurentz fits appear as shaded peaks.

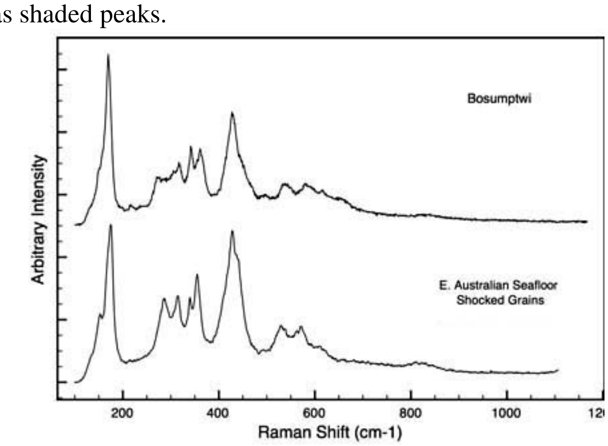

Figure 3. Raman spectra from TiO2-II granules in two different impact ejecta deposits. *Top*: Bosumtwi suevite acid residue. *Lower*: Australasian tektite horizon offshore eastern Australia [Ref 6]. Spectra were collected with the same device. Minor variances in wave number and intensity are attributed to crystal orientation and latent strain due to shock exposure.

Bosumtwi crater is the sixth known natural occurrence of TiO2-II. Previously (See references in [4]) it has been reported in core samples from theChesapeake Bay Impact Crater [5], in ejecta deposits from the Ries crater and the Australasian microtektite field, and in re-exposed tectonic subduction units in Germany and China. Recognition of TiO2-II at Bosumtwi crater, a well accepted impact structure, strengthens its possible use as a mineral criterion for impact shock history

References:[1]Littler et al., 1962. in Astrogeolic Studies Semiannual Progress Report, Feb 26 to Aug 26, 1961. *USGS Open-File report*, p.79-86. [2] McHone and Fries, 2007. *Meteoritics & Planetary Sci*. Vol 42, no 8, pA103,(Abstr #5321). [3]Personal communications to JFM. [4] El Goresey et al. 2001. A natural shock-induced polymorph of rutile with alpha PbO2 structure in the Ries crater in Germany, *Earth and Planetary Science Letters*, 192, p. 485-495.[5] Jackson et al. 2006. A shock-induced polymorph of anatase and rutile from the ChesapeakeBay impact structure, Virginia, USA, *American Mineralogist*, v.91, p. 604-608. [6] Glass B. P. et al., 2006. Raman spectroscopic study of shock-metamorphosed rock fragments recovered from the Austrolasian microtektite layer.GSA Annual Meeting 2006.