VREDEFORT COESITE CONFIRMED WITH RAMAN SPECTROSCOPY

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Vredefort Dome in South Africa is more than 120 km in diameter and nearly 2 billion years in age, making it one of earth's largest and oldest circular structures. In 1978 evidence for an extraterrestrial impact origin for the Vredefort Dome was strengthened when Martini [ref.1] reported both coesite and stishovite associated with thin veins of pseudotachylite from limited outcrops of northern collar rocks. These two minerals are high-pressure phases of silica and are widely regarded as diagnostic indicators for a sample's history of impact shock. Recent studies [ref.2] have revealed both coesite and stishovite widely distributed at numerous additional localities. Mineralogy was identified using X-ray diffractograms of insoluble HF acid residues, a method which may be subject to misinterpretations due to superimposed phase patterns and to precipitation of unwanted fluorides during sample digestion. In 1988 McHone and Nieman [ref.3] confirmed the presence of stishovite in powdered splits of Martini's Vredefort samples by using the independent, unambiguous technique of Solid-State Silicon-29 nuclear magnetic resonance. Coesite had been eliminated by acid digestion and could not be detected at that time.

We report here the *in situ* detection of coesite in a polished bulk sample using Raman spectroscopy. Raman scattering was excited in the sample using the 488 nm line of a Coherent (90-5) Ar+ ion laser. A laser beam was focused to various 5 micron spots on the polished Vredefort sample chip. The resulting Raman signal was collected using a 180° scattering geometry through a long working distance 50X Mitutoyo microscope objective mounted in a modified Olympus (BH-2) petrographic microscope. Raman scattering data were collected with an Instruments S. A. triple spectrometer (S3000) coupled with both a Princeton Instruments intensified diode array detector (IY-750) for multichannel detection and a photomultiplier tube for scanning mode detection. The spectrometer entrance slit was set at 150 microns giving a spectral resolution of approximately $15 cm^{-1}$. A polarization analyzer was used at the entrance of the spectrometer, and all reported spectra were obtained in an unpolarized (HV) scattering geometry. The spectra were taken from dark-colored (light brown to black) inclusions in a brown matrix located in quartzite just outside a 0.5mm-thick pseudotachylite vein.

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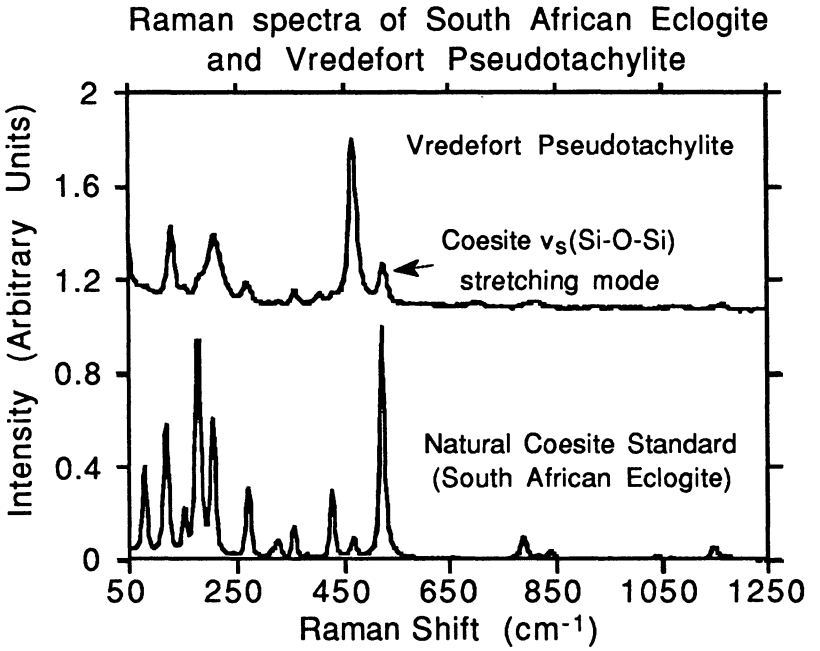
Spectra taken from the brown matrix showed only fluorescence probably due to iron. The Coesite was found to always be intermixed with Quartz. Examination of the Si-O-Si stretching mode of Coesite showed a shift to higher frequency relative to a specimen of endogenic eclogite coesite, indicating a strain of about 10 kbar(ref.4). This behavior has been observed in other mineralogical samples.



Raman spectroscopy has been used in this study as a non-destructive and unambiguous technique for identifying and confirming the presence of shock-induced coesite at the Vredefort Dome.

References:

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