Wassonite: The Discovery of a New Meteoritic Mineral

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Using state-of-the art instruments, researchers in the Robert M. Walker Laboratory for Space Science at Johnson Space Center (JSC) discovered a new mineral within a meteorite. The new mineral is a titanium sulfide and is named wassonite in honor of meteoriticist Professor John Wasson (University of California Los Angeles [UCLA]). The tiny grains of wassonite were found in the Yamato 691 enstatite chondrite, a rare type of meteorite that originated in the asteroid belt and later fell to Earth in Antarctica. Colleagues at UCLA recognized the wassonite grains as a potential new mineral. The team measured the chemical composition of the grains, but were unable to determine its other properties. A thin slice of one of the wassonite grains was nano-machined and extracted from the meteorite, using the focused ion beam instrument, for measurements with the JSC field-emission transmission electron microscope. The microscope analyses revealed the atomic structure of the grains, showing that wassonite has a relatively simple crystal structure consisting of alternating layers of titanium and sulphur atoms. Researchers measured the chemical composition of wassonite and the speciation of the constituent atoms using x-ray and electron spectroscopies at nearly the atomic scale. The textural relationship between wassonite and the other minerals in the meteorite (figure 1) are remarkably well-preserved in the focused ion beam section. These data were sufficient for the Committee on New Mineral Names of the International Mineralogical Association to give official approval for the name "wassonite." Titanium sulfide has been synthesized and studied by scientists for decades in the semiconductor industry, but it had never before been found in nature.

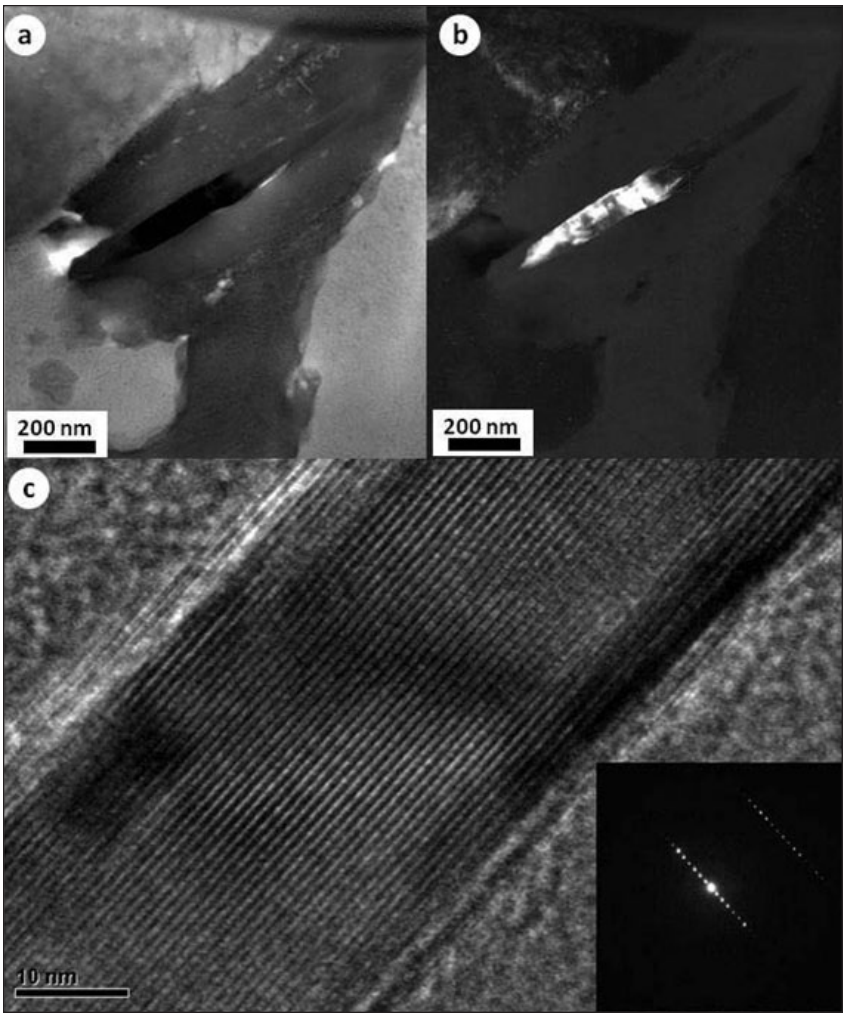

Fig. 1. *Wassonite grain in the Yamato 691 meteorite: (a) bright field transmission electron microscope image showing a wassonite grain in dark contrast; (b) high angle annular dark field transmission electron microscope image of the same grain; (c) high-resolution transmission electron microscope image of wassonite grain from the boxed area in (a). Inset is the selected area electron diffraction pattern of wassonite.*

In the vast majority of minerals, titanium is bonded to oxygen and is referred to as a lithophile element. In wassonite, the titanium is bonded to sulfur, indicating that it formed in a strongly reducing (oxygen-poor) environment at high temperatures (>1500 Kelvin). These conditions existed close to the sun in the early solar system approximately 4.5 billion years ago.