



PAPER ANNOUNCES DISCOVERY OF ONE OF EARLIEST MINERALS FORMED IN SOLAR SYSTEM

New Mineral Named Krotite, Found in Meteorite, Is Described in 'American Mineralogist'

Los Angeles—In the May-June issue of the journal *American Mineralogist*, a team of scientists announced the discovery of the new mineral krotite, one of the earliest minerals formed in our solar system. It is the main component of an unusual inclusion embedded in a meteorite (NWA 1934), found in northwest Africa. These objects, known as refractory inclusions, are thought to be the first planetary materials formed in our solar system, dating back to before the formation of the Earth and the other planets.



The “Cracked Egg” grain, in which krotite was discovered, is contained in the NWA 1934 Meteorite. (Image by Chi Ma)

This particular grain is known affectionately as “Cracked Egg” for its distinctive appearance. Dr. Harold C. Connolly, Jr. and student Stuart A. Sweeney Smith at the City University of New York (CUNY) and the American Museum of Natural History (AMNH) first recognized the grain to be of a very special type, known as a calcium-aluminum-rich refractory inclusion. (“Refractory” refers to the fact that these grains contain minerals that are stable at very high temperature, which attests to their likely formation as very primitive, high-temperature condensates from the solar nebula.)

Cracked Egg refractory inclusion was sent to Dr. Chi Ma at California Institute of Technology (Caltech) for very detailed nano-mineralogy investigation. Dr. Ma then sent it to Dr. Anthony Kampf, Curator of Mineral Sciences at the Natural History Museum of Los Angeles County (NHM), for X- ray diffraction study. Kampf’s findings, confirmed by Ma, showed the main component of the grain was a low-pressure calcium aluminum oxide (CaAl_2O_4) never before found in nature. Kampf’s determination of the atomic arrangement in the mineral showed it to be the same as that of a man-made component of some types of refractory (high-temperature) concrete.

What insight can we get from knowing that a common man-made component of modern concrete is found in nature only as a very rare component of a grain formed more than 4.5 billion years ago? Such investigations are essential in deciphering the origins of our solar system. The creation of the man-made compound requires temperature of at least $1,500^\circ\text{C}$ ($2,732^\circ\text{F}$). This, coupled with the fact that the compound forms at low pressure, is consistent with krotite forming as a refractory phase from the solar nebula. Therefore, the likelihood is that krotite is one of the first minerals formed in our solar system.

Studies of the unique Cracked Egg refractory inclusion are continuing, in an effort to learn more about the conditions under which it formed and subsequently evolved. In addition to krotite, the Cracked Egg contains at least eight other minerals, including one other mineral new to science.

The *American Mineralogist* paper is entitled “Krotite, CaAl_2O_4 , a new refractory mineral from the NWA 1934 meteorite.” It is authored by Chi Ma (Caltech), Anthony R. Kampf (NHM), Harold C. Connolly Jr. (CUNY and AMNH), John R. Beckett (Caltech), George R. Rossman (Caltech), Stuart A. Sweeney Smith (who was a NSF

funded Research for Undergraduate (REU) student at CUNY/AMNH) and Devin L. Schrader (University of Arizona). Krotite is named for Alexander N. Krot, a cosmochemist at the University of Hawaii, in recognition of his significant contributions to the understanding of early solar system processes.

About the Natural History Museum

The NHM is a national leader in research, exhibitions and education. It was the first dedicated museum building in Los Angeles, opening its doors in 1913 and has since amassed one of the world's most extensive and valuable collections of natural and cultural history — with more than 35 million objects, some as old as 4.5 billion years. The Natural History Family of Museums includes the NHM, the Page Museum at the La Brea Tar Pits (Hancock Park/Mid-Wilshire), and the William S. Hart Museum (Newhall, California). Visit www.nhm.org or call (213) 763-DINO.

NHM Next Transformation

The completed renovation of the Natural History Museum's Beaux-Arts 1913 Building sets the stage for the Museum's rollout of new visitor experiences leading up to the Museum's centennial in 2013. The milestone re-opening of the 1913 Building began in 2010 with new exhibitions inside its iconic Rotunda and the new exhibition *Age of Mammals*. On July 16, 2011, the Museum debuts its new Dinosaur Hall. An exhibition focusing on the Southern California's natural and cultural history will open in 2012, and over 2012 and 2013, 3.5 acres of outdoor nature experiences, the North Campus, and their indoor component, the Nature Lab, open.