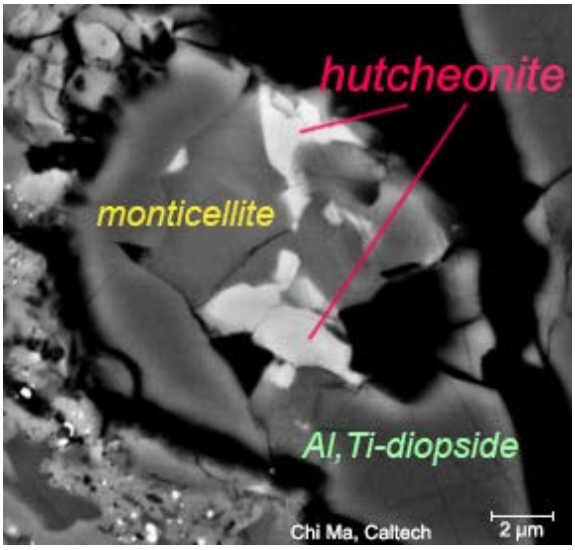
PLANETARY SCIENCE RESEARCH PSRD Discoveries

Headline Article

September 16, 2013

Discovery of a New Garnet Mineral, Hutcheonite, in the Allende Meteorite



--- A new titanium-rich garnet mineral discovered in a CAI in Allende is named in honor of Ian D. Hutcheon.

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A new titanium-rich garnet mineral has been found in a **FUN CAI** (a rare type of calcium-aluminum-rich inclusion, **CAI**) from the Allende carbonaceous chondrite, as reported by the discovery team of Chi Ma (CalTech) and Alexander Krot (University of Hawai'i). The mineral, IMA 2013-029, was officially approved in June 2013 by the *Commission on New Minerals, Nomenclature, and Classification* of the *International Mineralogical Association* as hutcheonite. The mineral's name honors Ian D. Hutcheon, a researcher at Lawrence Livermore National Laboratory, who is a leading authority in the chronology of the early Solar System, especially known for his significant contributions to the development of instrumentation and techniques for isotopic and elemental microanalysis. Researchers Ma and Krot say hutcheonite in Allende is likely an alteration phase formed by iron-alkali-halogen **metasomatism** of the primary phases in the FUN CAI.

Reference:

- Ma, C. and Krot, A. N. (2013) Discovery of a New Garnet Mineral: An Alteration Phase in Allende, *Meteoritical Society 76th Annual Meeting,* **abstract no. 5049**.
- **PSRDpresents:** Discovery of a New Garnet Mineral, Hutcheonite, in the Allende Meteorite --**Short Slide Summary** (with accompanying notes).

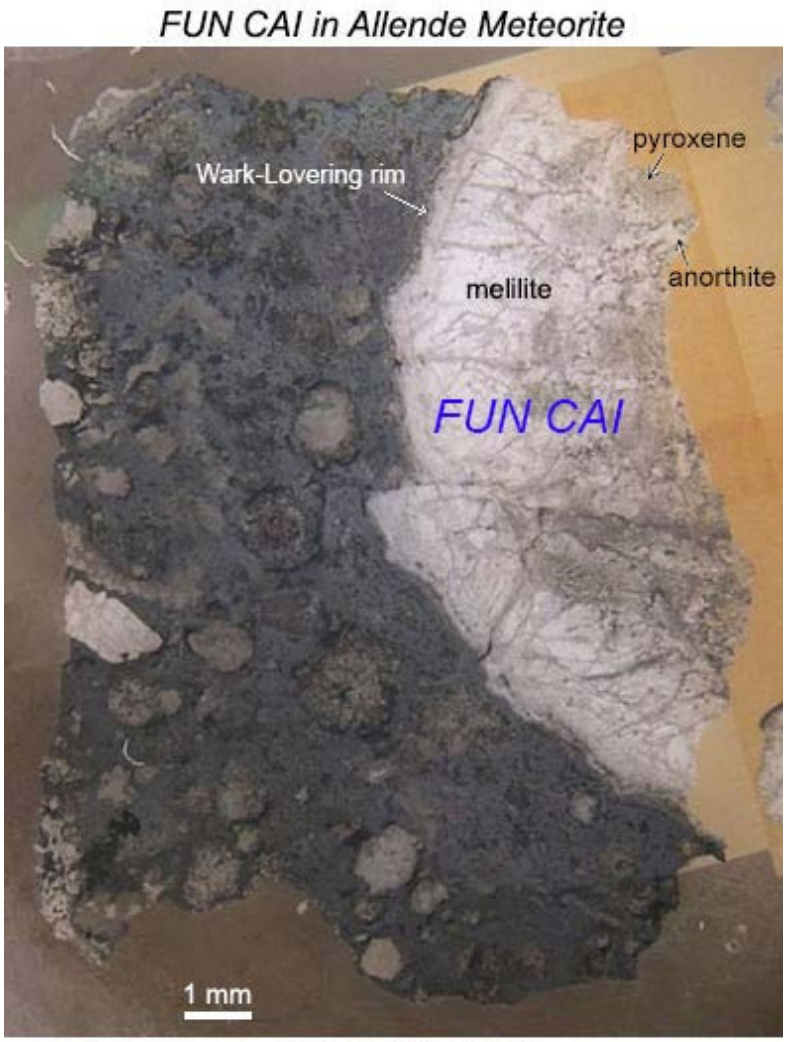
Investigating the Tinest Components of the Allende Meteorite

Advances in high-resolution instrumentation and analysis techniques make it possible for researchers to study finer and finer details, even in samples subjected to decades of examination as is the case for the Allende CV3 carbonaceous chondrite that fell in 1969 [**Data link** from the Meteoritical Bulletin], and is one of the most studied meteorites in history. Since 2007 fourteen new minerals have been discovered in Allende by techniques described by Chi Ma as nanomineralogy, "the study of Earth and planetary materials at nanometer scales, focused on characterizing nanofeatures (like inclusions, exsolution, zonation, coatings, pores) in minerals and

revealing nanominerals and nanoparticles" (see his **nanomineralogy page** at Caltech). These minerals are listed below in chronological order of discovery (see his **webpage** at Caltech for details). New mineral panguite was highlighted in many news outlets in 2012, including a **PSRD CosmoSparks report**. The twelfth new mineral—hutcheonite—is a garnet (and for those keeping score it's in the schorlomite group/garnet supergroup with cubic space group *Ia-3d*) with the chemical formula $Ca_3Ti_2(SiAl_2)O_{12}$ as reported by Chi Ma and Alexander Krot.

NEW MINERALS IN ALLENDE	FORMULAS
allendeite	$Sc_4Zr_3O_{12}$
hexamolybdenum	(Mo,Ru,Fe)
monipite	MoNiP
tistarite	Ti_2O_3
davisite	$CaScAlSiO_6$
grossmanite	$CaTi^{3+}AlSiO_6$
hibonite-(Fe)	$(Fe,Mg)Al_{12}O_{19}$
panguite	$(Ti,Al,Sc,Mg,Zr,Ca)_{1.8}O_3$
kangite	$(Sc,Ti,Al,Zr,Mg,Ca)_{1.8}O_3$
majindeite	$Mg_2Mo_3O_8$
nuwaite	Ni_6GeS_2
hutcheonite	$Ca_3Ti_2(SiAl_2)O_{12}$
paqueite	$Ca_3TiSi_2(Al_2Ti)O_{14}$
burnettite	$CaVAlSiO_6$
- - - - - - - - From *Chi Ma's webpage at Caltech*. - - - - - - - -	

Ma and Krot showed the results of their scanning electron microscopy and electron microprobe analyses of this new titanium-rich garnet at the 76th annual meeting of the Meteoritical Society on July 30, 2013 and announced the mineral's name hutcheonite, in honor of Ian D. Hutcheon, a cosmochemist and physicist at Lawrence Livermore National Laboratory. Hutcheonite occurs as grains 500 nm to 4 μm in size, along cracks between minerals in the core of a ~1.5 centimenter-diameter, course-grained Type B1 FUN CAI named Egg-3. CAIs, including this one, have been well-studied for nearly four decades because of their variations in isotopic compositions and what they tell us about the first solids in the Solar System (see the series of **PSRD articles covering CAIs**).



(Courtesy of Chi Ma, Caltech)

This optical image of a slice of the Allende meteorite shows the light-colored Egg-3 FUN CAI on the right. Minerals melilite, pyroxene, and anorthite are identified. Other minerals in the FUN CAI (too small to label) include Al,Ti-diopside and spinel. Ma and Krot also identified a Wark-Lovering rim of Al,Ti-diopside and forsterite (magnesium-rich olivine).

IAN D. HUTCHEON

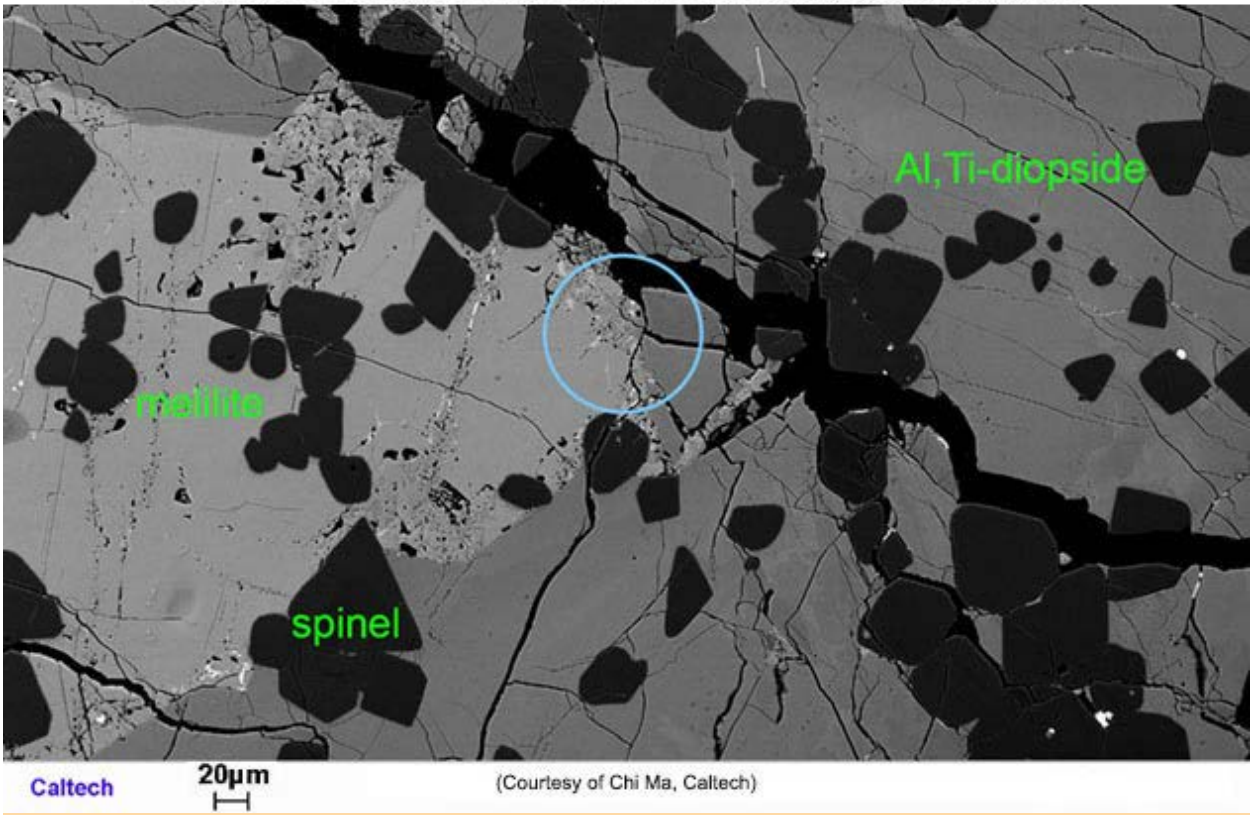
(Photo courtesy of Nan Hutcheon.)

The new mineral's name honors Dr. Ian D. Hutcheon whose work also includes isotopic analyses of the Egg-3 FUN CAI in Allende.

The Context of Hutcheonite in Allende

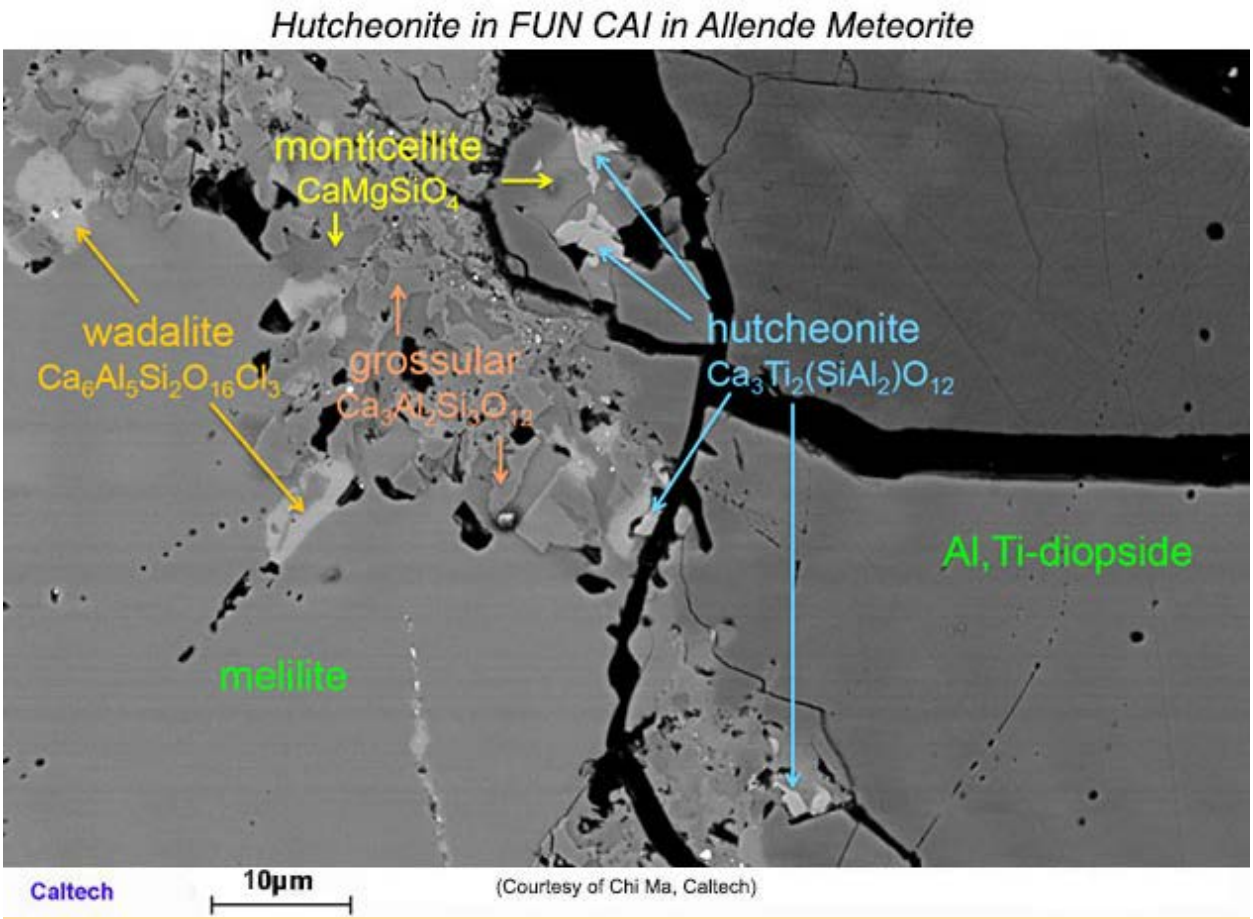
The mantle-core area of the Egg-3 FUN CAI in Allende is composed of primary melilite, spinel, and Al,Ti-diopside (see images below). Ma and Krot found hutcheonite along cracks between these minerals and in association with secondary minerals wadalite, monticellite, and grossular (labeled in the lower image).

Occurrence of Hutcheonite in FUN CAI in Allende Meteorite



(Courtesy of Chi Ma, Caltech)

The blue circle in this backscattered electron image identifies a location where hutcheonite was found in the core area of the Allende Egg-3 FUN CAI. See enlargement in the following image.



Hutcheonite occurs in contact with monticellite (calcium-magnesium olivine) as shown in this backscattered electron image of the Allende Egg-3 FUN CAI. Hutcheonite can also occur with grossular (calcium-aluminium garnet), and wadalite (calcium-aluminium-chlorine silicate).

Origin of Hutcheonite as an Alteration Silicate

The geochemistry and mineralogy of the Egg-3 FUN CAI reveal a history of alteration processes that occured on the asteroid parent body of Allende. Based on their nanomineralogy research, Ma and Krot suggest fluid alteration in this FUN CAI resulted in the addition of chemical elements silicon, sodium, chlorine, iron, and barium, the loss of calcium, and the mobilization of titanium. They propose the Ti-rich mineral hutcheonite formed by iron-alkali-halogen **metasomatism** of the primary phases in Egg-3, such as melilite and Al,Ti-diopside.

Additional Resources

Links open in a new window.

- **PSRDpresents:** Hutcheonite --**Short Slide Summary** (with accompanying notes).
- Ma, C. and Krot, A. N. (2013) Discovery of a New Garnet Mineral: An Alteration Phase in Allende, *Meteoritical Society 76th Annual Meeting,* **abstract no. 5049** (pdf).

- Ma, C. and Krot, A. N. (2013) Hutcheonite, IMA 2013-029. CNMNC Newsletter No. 16, August 2013, page 2707, *Mineralogical Magazine*, v. 77, p. 2695-2709. [**web link**]
- News release: Early Solar System Garnet-like Mineral Named for Livermore Cosmochemist (August 13, 2013) by Anne M. Stark. [**web link**]

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