

Addendum

Mineralogy of meteorite groups: An update

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Abstract—Twenty minerals that were not included in the most recent list of meteoritic minerals have been reported as occurring in meteorites. Extraterrestrial anhydrous Ca phosphate should be called merrillite, not whitlockite.

ADDITIONAL METEORITIC MINERALS

Rubin (1997) listed ~275 mineral species that have been identified in meteorites. Since publication of that paper, 20 additional meteoritic minerals have come to light; most of these are listed in Table 1, which is in the same format as Table 2 of Rubin (1997). Not included in Table 1 are two new unnamed species: an MgSiO_3 phase with the ilmenite structure found in shock veins in the L5-6, S6 chondrite, Acfer 040 (Sharp *et al.*, 1997) and a nesosilicate of formula $(\text{NaKCaFe})_{0.973}(\text{Al,Si})_{5.08}\text{O}_{10}$ found in the shocked matrix of L6 Peace River (El Goresy *et al.*, 1997). The list of presolar minerals (Table 4 of Rubin, 1997) should also include spinel (A. M. Davis, pers. comm., 1997). The list of minerals in martian meteorites (Table 5 of Rubin, 1997) should also include ringwoodite and majorite.

MERRILLITE AND WHITLOCKITE

There has been great confusion over the names merrillite and whitlockite (Mason, 1971). The *Mineral Reference Manual* of Nickel and Nichols (1991) lists merrillite as a synonym for whitlockite, and most authors use the terms interchangeably when describing anhydrous Ca phosphate in lunar rocks and meteorites. However, there appear to be chemical and structural differences between the phases. Merrillite, $\text{Ca}_9\text{MgNa}(\text{PO}_4)_7$, in Estacado (H6) and the Angra dos Reis angrite has a structure essentially identical to that of synthetic $\beta\text{-Ca}_3(\text{PO}_4)_2$ (Gopal and Calvo, 1972; Prewitt and Rothbard, 1975; Dowty, 1977). In contrast, in natural and synthetic whitlockite, $\text{Ca}_9\text{MgH}(\text{PO}_4)_7$, one of the tetrahedral PO_4 groups is inverted, thus forming a structure somewhat different than $\beta\text{-Ca}_3(\text{PO}_4)_2$ (Gopal and Calvo, 1972; Gopal *et al.*, 1974; Calvo and Gopal, 1975).

According to e-mail dated 1996 April 17 from E. Nickel, vice chairman of the Commission on New Minerals and Mineral Names (CNMMN) of the International Mineralogical Association (IMA), to B. Mason, a proposal by E. Dowty to revalidate merrillite was approved by the CNMMN in 1976. Thus, extraterrestrial anhydrous Ca phosphate should be called merrillite.

ERRATA

The oxide of formula MgTiO_3 called geikielite was misspelled in Table 2 of Rubin (1997). The correct name for the phosphate of formula $\text{Ca}_5(\text{PO}_4)_3\text{OH}$ is hydroxylapatite. Presolar SiC is cubic; the proper name for this mineral is beta-moissanite. The inosilicate, Scfassaite, should more properly be termed "Al-Ti diopside, scandium bearing." The mineral entry in Table 2 of Rubin (1997) labeled monosulfide solid solution should be omitted. This phase does not occur at room temperature; at S-poor compositions, it exsolves pentlandite below 610 °C, forms two miscibility gaps below 300 °C (one at each side of the Fe/Ni = 1 composition) and finally breaks down to form troilite or pyrrhotite below 100–200 °C (Craig and Scott, 1974).

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TABLE 1. Additional minerals in meteorites.

Mineral	Formula	References
	<i>native elements and metals</i>	
rustenburgite	$(\text{Pt,Pd})_3\text{Sn}$	1
	<i>sulfides and hydroxysulfides</i>	
digenite	Cu_9S_5	1
	<i>arsenides and sulfarsenides</i>	
irarsite	$(\text{Ir,Ru,Rh,Pt})\text{AsS}$	1
	<i>oxides</i>	
zirkelite	$(\text{Ca,Th,Ce})\text{Zr}(\text{Ti,Nb})_2\text{O}_7$	1
	<i>hydroxides</i>	
feroxyhyte	$\delta\text{-FeO}(\text{OH})$	1
	<i>sulfates</i>	
coquimbite	$\text{Fe}_2(\text{SO}_4)_3 \cdot 9\text{H}_2\text{O}$	1
kieserite	$\text{MgSO}_4 \cdot \text{H}_2\text{O}$	1
slavikite	$\text{NaMg}_2\text{Fe}_5(\text{SO}_4)_7(\text{OH})_6 \cdot 33\text{H}_2\text{O}$	1
szomolnokite	$\text{FeSO}_4 \cdot \text{H}_2\text{O}$	1
voltaite	$\text{K}_2\text{Fe}_3\text{Al}(\text{SO}_4)_{12} \cdot 18\text{H}_2\text{O}$	1
	<i>phosphates</i>	
galileiite	$\text{NaFe}_4(\text{PO}_4)_3$	2
K-Na-Fe phosphate	$(\text{K,Na})\text{Fe}_4(\text{PO}_4)_3$	2
	<i>silicates</i>	
	<i>nesosilicates (independent SiO_4 tetrahedra)</i>	
britholite-(Ce)	$(\text{Ce,Y,Ca})_5(\text{SiO}_4)_3(\text{OH,F})$	1
goldmanite	$\text{Ca}_3\text{V}_2(\text{SiO}_4)_3$	1
	<i>inosilicates (continuous single or double chains of SiO_4 tetrahedra)</i>	
donpeacorite	$(\text{Mn,Mg})\text{Mg}(\text{SiO}_3)_2$	1
kanoite	$(\text{Mn,Mg})\text{SiO}_3$	1
	<i>tectosilicates (continuous framework of SiO_4 tetrahedra)</i>	
marialite	$\text{Na}_4(\text{Si,Al})_{12}\text{O}_{24}\text{Cl}$	1
stilbite	$\text{NaCa}_4(\text{Si}_{27}\text{Al}_9)\text{O}_{72} \cdot 30\text{H}_2\text{O}$	1

References: 1 = Kimura (1996); 2 = Olsen and Steele (1997).

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