A NEW ANTARCTIC METEORITE WITH CHROMITE, ORTHOPYROXENE AND METAL WITH REFERENCE TO A FORMATION MODEL OF S ASTEROIDS; Hiroshi Takeda, Kazuto Saiki Mayumi Otsuki, Mineralogical. Inst., Faculty of Science, Univ. of Tokyo, Hongo, Tokyo 113, Japan and Takahiro Hiroi, SN3, NASA Johnson Space Center, Houston, Texas 77058.

Mineralogy of a unique meteorite from Antarctica, EET84302 and the related primitive achondrites has been studied to gain better understanding on relationship between S asteroids and this meteorite group. EET84302 consists of metal-rich (M) region with metal filling interstices of silicate grains of orthopyroxene (Opx), olivine Fa8, plagioclase An24', and augite (Aug), chromite-rich (C) region with major chromite and Opx, and silicate-rich (S) region with mainly Opx. This is the first example of chromite-rich achondrite. Distribution of three areas (C, M, S) are in line with a proposed model of primitive achondrites and S asteroids.

Since reflectance spectra of some members of primitive achondrites combined with those of iron meteorites, resemble those of the S asteroids [1], there is an expectation that S asteroids are modified products of chondrites [2]. The trends of the variations in their mineral assemblages are in line with those of the S asteroids [2]. Hiroi et al. [1] proposed a stony-iron model of S asteroids, which assumes that a few domains of various primitive achondrites are embedded in iron matrix.

Polished thin sections (PTS) of EET84302,19 and ALH81187,16 have been supplied from Meteorite Working Group (MWG). A previously studied PTS of EET84302 was similar in both texture and mineralogy to silicate inclusions in some iron meteorites [3]. We have studied PTS EET84302,19 by electron probe microanalyzer (EPMA) and scanning electron microscope (SEM). The reflectance spectra of EET84302 showed a weathering problem and has not been used to match with those of S asteroids [1].

EET84302,19 is an Opx-rich meteorite with their grain boundaries filled with complex veins and amoeboid grains of opaque minerals (Fig. 1). One third of the PTS (C area) is richer in chromite and its grains are interconnected to form a domain of chromitite with rounded inclusions of silicates (Opx). Another area is richer in metal (M area), but their amoeboid grains are isolated. In the middle of two distinct areas, there is a silicate rich area (S) similar to metal-poor lodranite MAC88177 [2]. In a transitional zone, two joined amoeboid grains of opaque minerals have a sharp boundary between metal and chromite (Fig. 1). Modal abundances of minerals of EET84302,19 are: Opx 49 vol.%, olivine 4 %, plagioclase 6 %, Aug 0.7 %, whitlockite 0.2 %, chromite 23 %, and metal 14 %.

The Opx crystals in EET84302 often have dusty cores similar to those in shock recrystallized diogenite (Y74013-type) [4]. The chemical compositions of Opx Ca2.4Mg88.6Fe8.0 is more reduced than those of lodranites [2], and their Ca contents decrease towards the rims Ca12.9Mg15.5Fe7.3. No exsolution was detected in Opx or Aug optically. Their compositions give the last equilibrated temperature of 1050-800°C [5]. ALH81187 is acapulcoite showing dusty appearance induced by shock reduction. Their mg numbers Mg X 100/(Mg+Fe) mol % is lower than those of Y75274 and Y8002 [6,7].

The silicate minerals closer to the C area are mostly Opx, but an area closer to the M area contains more olivine, plagioclase and augite than S. The plagioclase compositions range from An21 to An24, but they are still within the Ca-richer end of the compositional variations of a shock.
recrystallized LL7 chondrite [8]. The chromite compositions are Mg-rich
\((\text{Mg}_{0.52}\text{Fe}_{0.42}\text{Mn}_{0.02}\) \((\text{Cr}_{1.66}\text{Al}_{0.33})_4\). The metal grains contain Ni 5 to 6
wt%, CO 0.5-0.6%, and rarely includes ellipsoidal grains of a (Ni,P)-rich
mineral (ca. Fe,NiP).

A chromite-Opx assemblage is found in diogenites [4], but the texture
of chromite is different. It is to be noted that amoeboid shapes of metal
and chromite are nearly identical (Fig. 1). The texture suggests that these
opaque minerals were formed by migration of materials through grain bound-
aries. We admit that there is no experimental phase relation to support the
idea, but the materials may be supplied as Fe-Ni-S eutectic melt with Cr and
P or Cr may be supplied as primitive liquid or a melt rich in \(\text{Cr}_2\text{O}_3\).

As origin of chromitites, a few models of chromite formation have been
proposed. Near absence of olivine in the C area favors the formation of
chromite from olivine and Cr-rich melt as (Private comm., Z. Johan, 1992):
\[\text{MgFeSiO}_4 + \text{Cr} = \text{FeCrO}_4 + \text{MgSiO}_3\]

Kimura et al. [7] suggested that chromites in winonaites may have crystal-
lized from a sulfide-metal liquid under reducing conditions. By a mechanism
proposed by Irvine [9], the concentrated chromite is precipitated from
chromite-saturated liquid when this liquid is blended with earlier liquid of
the same type. The heterogeneous distribution of the C, M, S areas is in
line with our proposed model of S asteroids [1,2]. Evidence of migration of
materials through grain boundaries and the presence of dusty cores as in the
shock recrystallized chondrites and diogenites is in accordance with a
formation model of primitive achondrites by heating due to planetesimal
scale collision in addition to the decay of \(\alpha\)-Al [2].

We thank MWG for the meteorite samples. Drs. Z. Johan, H. Ozawa, T. J.
McCoy, J. Saito, T. Ishii and Profs. M. Miyamoto and K. Keil for discussions
and Mr. H. Yoshida, O. Tachikawa, Mrs. K. Hashimoto and M. Hatano for
technical assistance.

Ibid 5, 165-190.  [8] Takeda
H., Huston T. J. and Lipschutz
5, 273-277.

Fig. 1. Image processed PTS
photograph of EET84302,19.
Width is 8.3 mm. Note inhomoge-
neous distribution of C
(chromite), S(Opx etc.) and,
M(metal) areas. Unmarked
striped portion is oxidized metal.