FELDSPAR-CHROMITE MINERAL ASSEMBLAGE IN ORDINARY CHONDRITES: B. Walker, J. Hu and T.G. Sharp School of Earth And Space Exploration, Arizona State University, Tempe, AZ 85278, U.S.A. Balie.Walker@asu.edu

Introduction: Mineral assemblages in equilibrated chonrites provide important information on parent body processes such as thermal and shock metamorphism. Chromite is an important accessory mineral in chondrites that commonly occurs as finely disseminated crystals within plagioclase or maskelynite. In general, we will refer to these intergrowths as chromite-plagioclase intergrowths. The origin of chromite-plagioclase intergrowths is unclear. They have been observed in chondrules and interpreted as primary chondrule features [1] and they have been observed in equilibrated chondrites and interpreted as an indicator of shock [2]. In this study we examine chromite-plagioclase intergrowths in 12 ordinary chondrites that span a range of petrologic types from 4 to 6 and shock stages S1 to S6. The purpose is to determine possible origins of these intergrowths and test the hypothesis that they are an indicator of shock metamorphism [2].

Methods: We used polarizing light microscopy and reflected light microscopy with Olympus petrologic microscope to survey samples. High-resolution imaging and chemical analyses were obtained with field-emission scanning electron microscopy (FESEM) and energy-dispersive X-ray spectroscopy (EDX) using an FEI XL FESEM in the Leroy Erying Center for Solid State Science at ASU.

Results: Twelve samples were used in this project; Thika (L6 S1), New Concord (L6), Marion (Iowa (L6), Leedey (L6), Aleppo (L6), Roosevelt County 106 (L6 S6), ACFER 040 (L6 S6), Northwest Africa 757 (LL6 S4-6), MBALE (L5/6), Richmond (LL5), Cottonwood (H5) and Kediri (L4). All samples except Keiri (L4) contain some form of chromite-plagioclase assemblages. Nine of the 12 samples contained multiple forms of the chromite-plagioclase intergrowths. The chromite occurs as finely disseminated inclusions in 20-50µm grains of plagioclase or maskelynite. The chromite crystals are euhedral to subhedral chromite and range from sub-µ, to several µm in size.

We describe four different chromite-plagioclase intergrowth textures that commonly occur in these samples. *Clustered Chromite,* is defined by a core of plagioclase or maskelyninte with disseminated chromite inclusions inside chromite-free plagioclase or maskelynite (Fig. 1). The chromites have variable shapes and sizes with no evidence of preferred orientations or fabrics. *Orientated Chromite* are disseminated crystals with preferred orientations of elongated crystals. ACFER 040 (L6 S6), which contains abundant finely disseminated chromites in large maskelynites, contains elongate chromites that are orientated along two nearly orthogonal directions (Fig. 2). *Scattered Chromite.* Scattered chromite is characterized by random distribution of disseminated chromite inclusions. These chromite inclusions have nonuniform shapes and sized with no shape preferred orientations or fabrics (Fig 3). *Barred Chromite* is characterized by bands of chromite-rich plagioclase of maskelynite separated by bands of inclusion-free plagioclase of maskelynite (Fig. 4). This texture contains equi-dimensional chromite crystals with no shape preferred orientations.

In the highly shocked samples (S4-S6) there is no spatial correlation between melt veins and chromite-maskelynite intergrowths. EDX results from ACFER 040 (L6 S6) and Northwest Africa 757 (LL6 S4-6) indicate very little chemical variation between maskelynites that contains disseminated chromite and those that do not.

Discussion: The chromite-plagioclase intergrowths observed here are not correlated petrologic type or shock classifications. Samples of petrologic type L6 (Thinka, New Concord, Marion, Lowa, Leedey, Aleppo, Roosevelt County 106, ACFER 040 Northwest Africa 757 (LL6), and MBALE (L5/6) all have similar chromite-plagioclase intergrowth textures, commonly containing at least two of the four intergrowth textures. Samples of petrologic type 5, Richmond (LL5) and Cottonwood (H5), both do not have shock classification but contain well defined intergrowth textures, and neither have any chromite-maskelynite intergrowths, initial observations indicate these samples are not shocked.

The lack of correlation between the chromite-maskelynite intergrowth textures and highly-localized shock features in S4 to S6 samples (ACFER 040 (S6), Roosevelt County 106 (S6), and Northest Africa 757 (S4-6) suggests that the dissemination of chromite is not part of the shock process. Orientated chromites, like those in ACFER 040 (Fig. 2), have a twin-like arrangement that suggests a crystallographic relation between the chromite and plagioclase. This suggests that this intergrowth existed before shock transformed plagioclase to maskelynite. It is possible that chromite-plagioclase intergrowths formed from an early shock event followed by post shock annealing [2]. However, one would expect Ostwald ripening of the chromites

during annealing. The lack of Ostwald ripening may reflect a low surface energy between chromite and plagioclase.

The chromite-plagioclase intergrowth textures appear to be primary texture within chondrules. The barred chromite intergrowths appear to be a relict of that primary texture. We suggest that the clustered chromite, which contains plagioclase-chromite intergrowth surrounded by plagioclase, is a result of chromite-free plagioclase growing over primary chromite-plagioclase intergrowths during metamorphism. The chromite-plagioclase intergrowths observed in this study are likely a relic of preexisting chromite-plagioclase intergrowths in chondrules

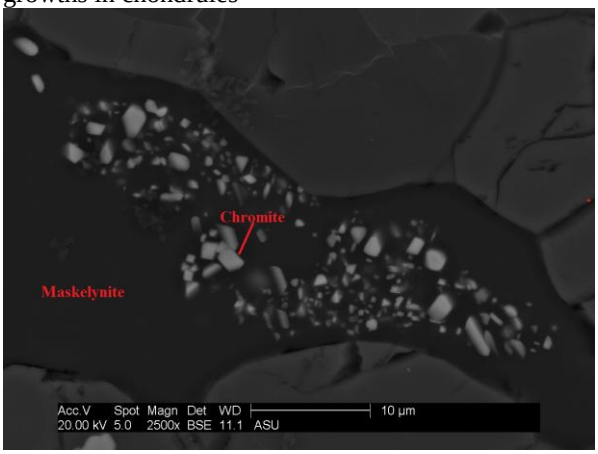

Figure 1 SEM Image of clustered chromite. Chromite (white/grey)-Maskelynite (dark grey) intergrowth texture observed in ACFER 040. Visible are clusters of maskelynite with disseminated chromite that are surrounded by chromite-free maskelynite

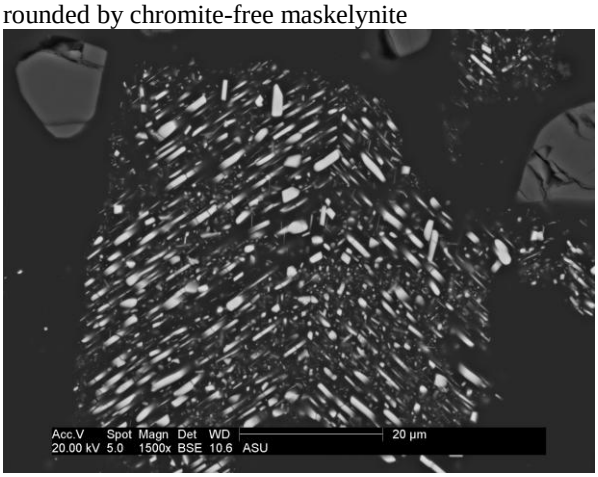

Figure 2 SEM image of orientated chromite. Intergrowth texture of chromite-maskelynite that is a cluster chromite intergrowth with orientated nearly orthogonal arrangement of chromite crystals.

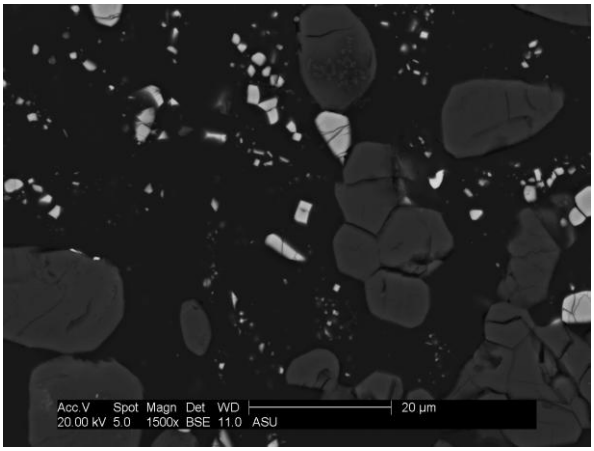

Figure 3 SEM Image of scattered chromite showing randomly disseminated chromites with variable shapes and sizes.

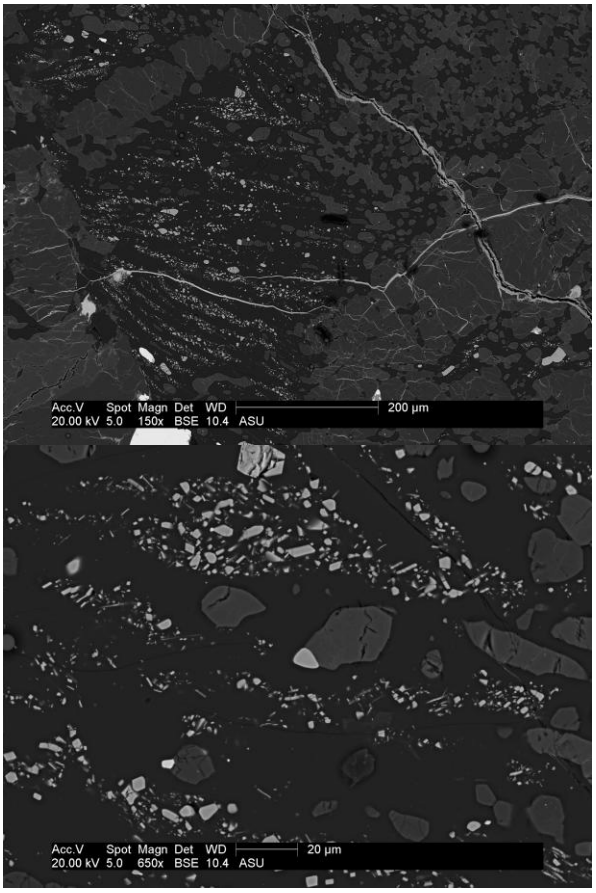

Figure 4 SEM Image of barred chromite showing bands of chromite-rich maskelynite separated by bands of chromite-free maskelynite. Upper image showsthe bar texture. Lower shows details of that texture

References: [1] Ramdohr, P. Geochimica et Cosmochimica Acta Volume 31; No. 10; 1961-1967. [2] Rubin, A. Geochimica et Cosmochimica Acta (ISSN 0016-7037); Volume 67; No. 14; 2