QUE94201: A NEW AND DIFFERENT SHERGOTTITE. Meenakshi Wadhwa[1] and Ghislaine Crozaz[2]. [1]Dept. of Geology, Field Museum of Natural History, Roosevelt Rd. at Lake Shore Dr., Chicago, IL 60605, [2]Dept. of Earth and Planetary Sciences and McDonnell Center for Space Sciences, Washington University, St. Louis, MO 63130.

The newly found Antarctic shergottite, QUE94201, provides the opportunity to study yet another putative sample from Mars. According to [1], it appears to be petrographically similar to the Zagami dark mottled lithology (DML) described by [2]. However, [1] observed in this meteorite growth features not previously recognized in pyroxenes of other shergottites. Unlike the homogeneous blocky cores commonly found in shergottite pyroxenes, they described "pyroxene cores consisting of nuclei of magnesian pigeonite, mantled by magnesian augite which, in turn, are rimmed by ferroan pigeonite, strongly zoned to pyroxferroite". In this study, we report ion microprobe measurements of REEs and other selected trace and minor elements in whitlockite (the major REE carrier in shergottites), maskelynite, and pyroxene. Relying on the extensive electron probe data set of [1], we analyzed 22 spots representing the range of pyroxene compositions.

As expected, whitlockite is the mineral with the highest REE concentrations in QUE94201. Its REE pattern (Fig. 1), like that of all other shergottite whitlockites [3], is LREE depleted and is characterized by a small negative Eu anomaly, a maximum at Tb, and then a smooth decrease to Lu. However, all REE concentrations are lower in QUE94201 whitlockite and its LREE pattern shows a steeper depletion (C1 normalized Sm/La~7.6) than in other shergottites (C1 normalized Sm/La$\leq$2). Similarly, REE abundances in QUE94201 maskelynite are lower (La~0.02xC1) than in the maskelynite of other shergottites (La>0.1xC1) and there is a sharp increase of the C1 normalized abundances from La to Sm (a factor of ~4.2) (Fig. 1). Such a LREE depleted pattern for maskelynite has not been observed in any of the other shergottites [3].

Pyroxenes in QUE94201 show a range of REE abundances. Representative REE patterns for the different pyroxene types described by [1] are shown in Fig. 2. All these patterns are strongly LREE depleted, with negative Eu anomalies. The pyroxenes are zoned not only in their REE concentrations, but also in the abundances of other trace and minor elements such as Y, Zr, Cr, V, Ti, and Al. In Fig. 3, Y concentrations in pigeonites of QUE94201 are plotted versus their Ti abundances, along with the compositions of pigeonites in the basaltic shergottites, Shergotty and Zagami, for comparison. While data for Shergotty and Zagami pigeonites as well as QUE94201 pigeonite nuclei and ferroan pigeonites define one continuous trend, data for QUE94201 pyroxferroites fall on a distinct trend. This may indicate that the pyroxferroite (which is overgrown on the ferroan pigeonite rims) formed from the influx of a highly fractionated melt different from that which resulted after the sequential formation of pigeonite cores, augite mantles, and ferroan pigeonite rims. Alternatively, it is possible that, following the formation of the ferroan pigeonite rims, phosphorus reached saturation in the melt and whitlockite began crystallizing and took up significant amounts of Y (and REEs), thereby causing a sharp drop in the Y concentration but not affecting the Ti abundances in the melt. In this scenario, the pyroxferroite would have formed from the evolved melt subsequent to whitlockite crystallization.

Using the modal abundances determined by [1] and the REE abundances we obtained for the various minerals, we estimated a REE composition for "bulk" QUE94201 from mass balance considerations (Fig. 1). This bulk composition has no Eu anomlay and is more fractionated in terms of its LREE depletion (C1 normalized Sm/La~7.8) than the whole-rock compositions of the other known shergottites. Also, using REE partition coefficients appropriate for the shergottite system [4], we calculated the compositions of melts in equilibrium with minerals in QUE94201. The REE pattern of the QUE94201 "parent melt", in equilibrium with pigeonite nuclei with the lowest REE abundances, is strongly LREE depleted (C1 normalized Sm/La ~7.5) and, in fact, approximately overlaps the estimated "bulk" REE composition shown in Fig. 1. Melts in equilibrium with subsequently formed minerals such as the augite mantle surrounding the pigeonite nuclei, ferroan pigeonite rims, pyroxferroite rims, maskelynite, and whitlockite are also LREE depleted and have REE patterns parallel to those of the calculated parent melt and bulk compositions. This argues for closed system crystallization, thereby supporting the hypothesis of whitlockite crystallization before pyroxferroite, rather than influx of a different melt for the formation of pyroxferroite. This

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sequence of crystallization is analogous to that in Zagami DN, in which phosphates also appear to have saturated relatively early in the crystallization history.

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