PCA82506: A UREILITE WITH LREE-ENRICHED COMPONENT AND A WHOLE-ROCK Sm-Nd MODEL AGE OF 4.55 Ga. Cyrena Anne Goodrich* and Günter W. Lugmair**. *Lunar and Planetary Laboratory, University of Arizona, Tucson, AZ 85721. **Scripps Institution of Oceanography, University of California, San Diego, La Jolla, CA 92093.

INTRODUCTION

Whole-rock Sm-Nd isotopic analyses of the ureilites Kenna, Novo Urei and ALHA77257, and a pyroxene separate from Kenna, fall on a 3.74 Ga isochron, indicating that these ureilites were chemically and isotopically equilibrated at this time [1]. None of the whole-rock analyses from this group have model ages of 4.55 Ga, which indicates that the 3.74 Ga event involved a change in bulk composition. In contrast, whole-rock analyses of the ureilites META78008 and ALH82130 yield precise model ages of 4.55 Ga, and two less-precise analyses of PCA82506 are consistent with a model age of 4.55 Ga (Rb-Sr isotopic systematics of these three ureilites indicate younger disturbance(s), however) [1]. A whole-rock analysis of another ureilite, LEW85440, neither has a model age of 4.55 Ga nor plots on the 3.74 Ga isochron [1]. Takahashi and Masuda [2] reported that META78008 has whole-rock Sm-Nd and Rb-Sr model ages of 4.55 Ga, but an internal age of 4.01 Ga. Altogether, these data indicate a varied and complex history for ureilites as a group.

Understanding this history depends critically on understanding the nature and origin of the unidentified "LREE-enriched component" [3] of ureilites. One possible interpretation of the 3.74 Ga event for the Kenna group is that it involved metasomatic introduction of LREE-enriched material to an ultramafic assemblage. If all ureilites that have model ages of 4.55 Ga lack LREE-enriched component, then this interpretation would lead to a relatively simple model: all ureilites formed as highly-depleted ultramafic assemblages at 4.55 Ga, and some of them reequilibrated with LREE-enriched material at 3.74 Ga. This model seems more plausible than one in which such an unusual component was generated repeatedly in the period 4.55 -> 3.74 Ga. No samples of META78008 or ALH82130 have yet been found to contain LREE-enriched component, although this component is known to occur extremely heterogeneously in some ureilites (Goodrich *et al.* [1] analyzed gram-sized samples of Kenna and found that some were apparently devoid of LREE-enriched component while some were dominated by it). The two samples of PCA82506 (,49 and ,64) analyzed by [1] were apparently devoid of LREE-enriched component. However, a subsample analyzed by Spitz and Boynton (unpublished) was found to contain the LREE-enriched component. It is therefore critical to know whether this ureilite has a whole-rock model age of 4.55 Ga. Thus, we have obtained another, more precise whole-rock analysis of PCA82506,64.

ANALYSIS AND RESULTS

The new subsample (,64-II) consisted of 0.41887 g of the same finely-ground powder from which our first sample (,64-I) was taken [1]. Results of the analysis are given in Table I and Figure 1 along with the previous data for PCA82506. The new sample has Sm/Nd and $^{143}Nd/^{144}Nd$ ratios that are significantly higher than those of the previous samples. Its Sm-Nd model age (I=0.5067) is 4.559±0.013 Ga. It also has higher Rb/Sr and $^{87}Sr/^{86}Sr$ ratios than the previously measured samples. Rb-Sr model ages for all three samples of PCA82506 are young, ranging from 3.3 to 3.9 Ga.

DISCUSSION

These results demonstrate significant heterogeneity of trace elements, particularly REE, in a supposedly homogenized powder. This heterogeneity is not likely to be due to variations in olivine/pyroxene ratio, because both olivine and pyroxene are highly REE-depleted and because they constitute the bulk of the sample. It is more likely due to inhomogeneous dispersal of a small number of minute LREE-enriched grains. This suggests that although these samples are highly LREE-depleted, they nevertheless contain small amounts of LREE-enriched component.

The new data for PCA82506 confirm that at least one ureilite known to contain LREE-enriched component has a whole-rock Sm-Nd model age of 4.55 Ga, thus ruling out the

relatively simple model discussed above. Further interpretation of this model age will require analysis of subsamples of PCA82506 containing significant amounts of LREE-enriched component, and determination of an internal age for this ureilite. We plan such analyses as the next step in our project. If whole-rock samples containing LREE-enriched component also have model ages of 4.55 Ga, then this ureilite must have acquired its LREE-enriched component at 4.55 Ga. In this case, an internal age younger than 4.55 Ga would suggest a closed-system metamorphic event. This would strengthen the interpretation that the 3.74 Ga isochron of the Kenna group ureilites records a metamorphic or igneous, rather than metasomatic, event (although for the Kenna group an open-system event is required by the lack of 4.55 Ga whole-rock ages).

If whole-rock samples of PCA82506 containing LREE-enriched component do not have model ages of 4.55 Ga, then PCA82506 may still be an unequilibrated mixture of an ultramafic assemblage formed at 4.55 Ga and a younger LREE-enriched component, and analysis of pure olivine and pyroxene separates from PCA82506 would be expected to yield ages of 4.55 Ga. We originally advanced a similar interpretation to explain the Kenna whole-rock data [4], and predicted that samples of Kenna devoid of LREE-enriched component (namely pure olivine and/or pyroxene) would have ages of 4.55 Ga. This theory was disproved, however, by analysis of a pyroxene separate, which plotted on the 3.74 Ga isochron [1].

Our new data for PCA82506 confirm that ureilites have had a varied and complex history, which is not yet well understood.

[1] C.A. Goodrich *et al.* (1991) *GCA* **55.** [2] K. Takahashi and A. Masuda (1990) *Abstr. 53rd MSM*, 167. [3] A.H. Spitz and W.V. Boynton (1986) *Meteoritics* **21**, 515; A.H. Spitz *et al.* (1988) *LPS* **19**, 1111. [4] C.A. Goodrich *et al.* (1989) *LPS* **20**, 347.

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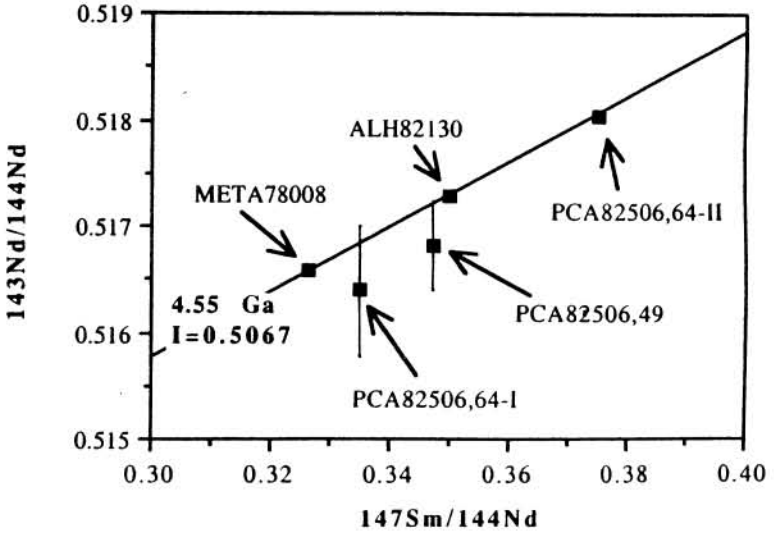

TABLE I: WHOLE ROCK ANALYSES OF PCA82506

	[Sm] ppb	[Nd] ppb	$^{147}Sm/^{144}Nd$	$^{143}Nd/^{144}Nd$	[Rb] ppb	[Sr] ppb	$^{87}Rb/^{86}Sr$	$^{87}Sr/^{86}Sr$
,64-II	2.254	3.635	0.3749	0.518046±22	9.68*	58.30	0.481*	0.721775±26
,64-I	2.18	3.93	0.3349	0.51639±62	8.58	57.2	0.4345	0.720560±35
,49	2.46	4.28	0.3472	0.51683±41	11	97.2	0.3267	0.717444±44

* Confirmation of these values is in progress.