

Distribution of rare earth elements, Th and U in R chondrite

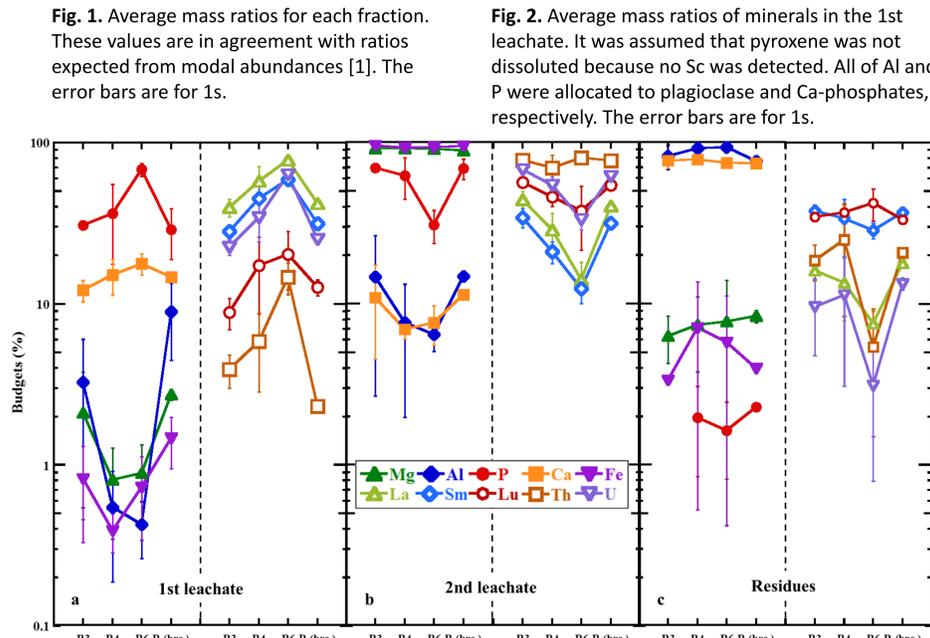
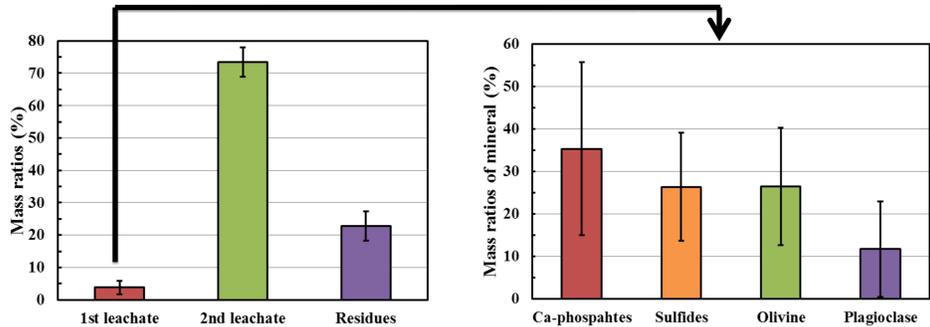
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Introduction

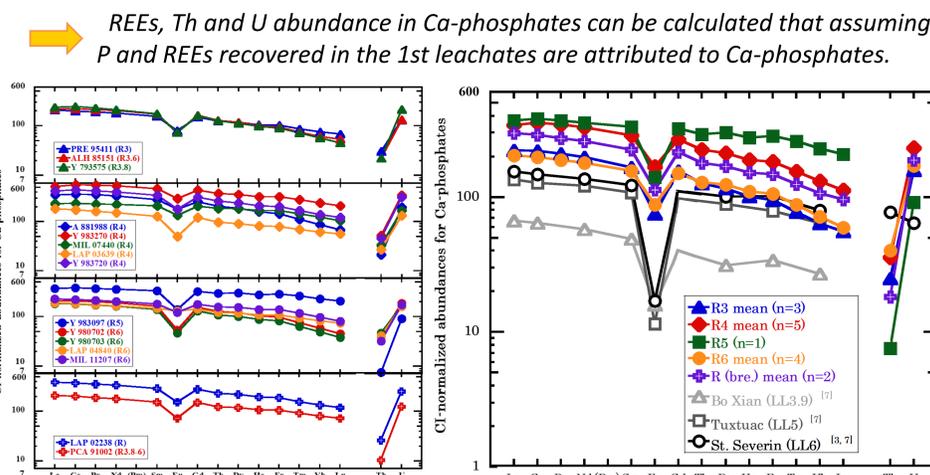
Mineralogical and chemical compositions of R chondrites are similar to those of ordinary chondrites (OCs) [1]. In the previous study [2], abundances of rare earth elements (REEs), Th and U in bulk R chondrites were reported to be almost equal to those of OCs. In OCs, major host phases for REEs, Th and U, and their budgets are well known [3, 4]. However, major host phases of these elements in R chondrite are not known. In this study, we investigated the distribution of REEs, Th and U in R chondrite by using chemical leaching technique for a goal of discussion of formation and/or metamorphism process of R chondrites.

Results & Discussion



Phosphorous, Ca, REEs, Th and U in the 1st leachate are similarly dissolved among different petrologic groups but Al doesn't follow those elements (Fig. 3a), which indicates that the Ca of this fraction is allocated to Ca-phosphates but not to plagioclase and that the P, REEs, Th and U are also allocated to Ca-phosphates.

REEs, Th and U abundance in Ca-phosphates can be calculated that assuming P and REEs recovered in the 1st leachates are attributed to Ca-phosphates.



The CI-normalized light REE (LREE) abundances in Ca-phosphates for R chondrites are variable from ~ 200 to 600 and significantly higher than those for OCs. The REE abundances in Ca-phosphates for R chondrites are not related to petrologic types, which is in contrast to the case for OCs.

Thus, it is suggested that ... REEs were distributed into Ca-phosphates through multiple stages.

Experimental

Sample information			
Meteorites	Classification ^[5]	Meteorites	Classification ^[5]
PRE 95411	R3	Y 983097	R5
ALH 85151	R3.6	Y 980702	R6
Y 793575	R3.8	Y 980703	R6
A 881988	R4	LAP 04840	R6
Y 983270	R4	MIL 11207	R6
MIL 07440	R4	LAP 02238	R
LAP 03639	R4	PCA 91002	R3.8-6
Y 983720	R4		

Analytical methods and elements determined

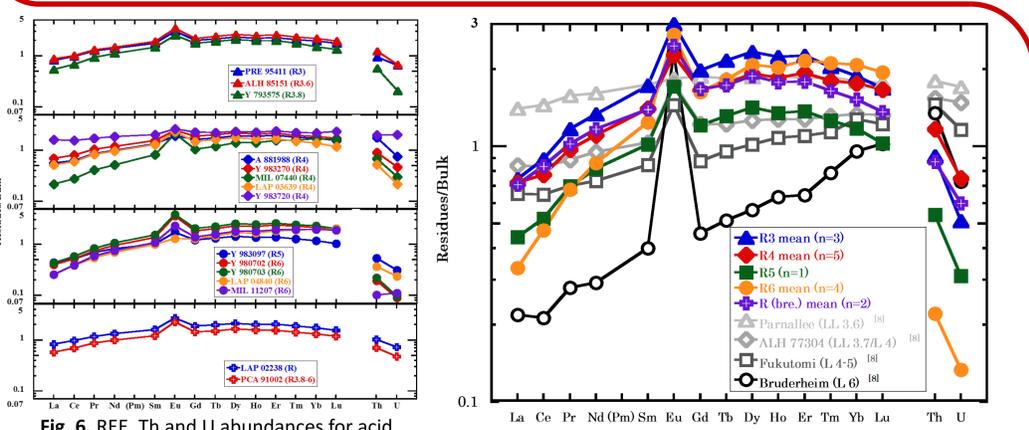
- ICP-AES (SPS 7800)
 - Mg, Al, Si[※], P, Ca, Sc, Ti, V, Mn, Fe, Co, Ni, Cu, Zn, Sr, Ba
- ICP-MS (iCAP Qc)
 - Ba, REEs, Th, U

※Silicon was analyzed for only the 1st leachate.

Sample processing

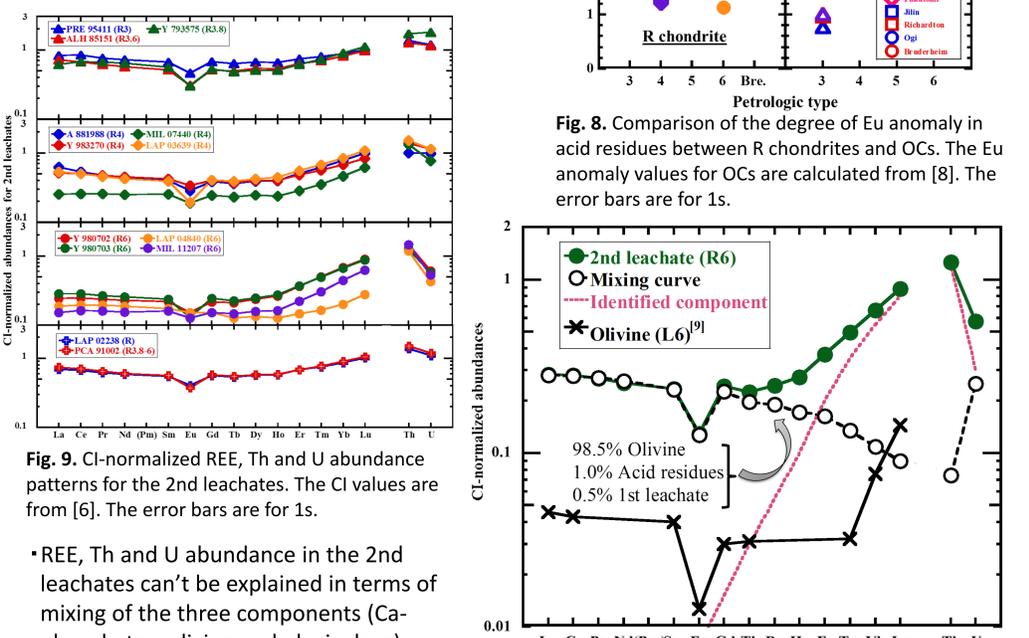
Powdered sample (~100 mg)

- 0.1 M HNO₃ (1mL; 5 min.) → 1st leachate (Ca-phosphates)
- 5 M HNO₃ (3 mL; 60 min.) × 3 → 2nd leachate (sulfides, olivine)
- Acid decomposition (149Sm spike for ID method) → Residues (plagioclase, pyroxene, oxides)



Heavy REE (HREE) abundances in acid residues of R chondrite are similar regardless of petrologic types, while LREE abundances are related to petrologic types like the case for OC.

The all patterns are convex upward with a positive Eu anomaly even in the case of R3, while unequilibrated OCs show is mostly flat patterns with no Eu anomaly. The Eu anomaly in acid residues of R chondrite isn't related to petrologic types, while it is related to petrologic types for OCs.



REE, Th and U abundance in the 2nd leachates can't be explained in terms of mixing of the three components (Ca-phosphates, olivine and plagioclase) assuming that REEs are partitioned into these minerals an equilibrium. None of these minerals contain unexplainably high HREE contents. Thus, it is reasonably assumed that HREE abundances in the 2nd leachates are largely contributed by an identified mineral(s).

Thus, it is suggested that ... Distribution of REEs, especially HREEs, in R chondrite is quite different from that in OC.

Summary

Distribution of REEs, Th and U in R chondrite was investigated by using chemical leaching.

- LREEs in R chondrite are mainly distributed to Ca-phosphates like the case of OCs.
- HREEs were largely recovered in the second acid-leachates. No reasonable candidates responsible for these HREEs could be identified so far.
- Distributions of REEs, Th and U in the acid residual phases are not related to petrologic types, which is in contrast to the case for OCs.

R chondrites and OCs experienced metamorphic activities in different ways on their parent bodies.

References

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