

Content

1. Introduction
2. The early REE market before the emergence of carbonatites
 - 2.1. Early production at Bastnäs
 - 2.2. Monazite from mineral sands
3. Demand for rare earths increases
4. The emergence of carbonatites in the REE market
 - 4.1. Karonge / Gakara
 - 4.1.1. Production of REE concentrate from Karonge/Gakara: 1948–1978
 - 4.1.2. Production of REE concentrate from Karonge / Gakara: 2017–Present
 - 4.2. Mountain Pass
 - 4.2.1. Mountain Pass sustained production: 1952–1998
 - 4.2.2. Mountain Pass in the process of shutting down: 1998–2002
 - 4.2.3. Mountain Pass rises from the ashes: 2012–2015
 - 4.3. Korsnäs
 - 4.4. Chinese carbonatites in the REE market
 - 4.4.1. Bayan Obo
 - 4.4.2. Weishan (a.k.a. Chisan, Chishan, or '101')
 - 4.4.3. Maoniuping
 - 4.4.4. Dalucao
 - 4.4.5. Lizhuang
5. Recent carbonatite production
 - 5.1. Mount Weld
 - 5.2. Dong Pao
6. Carbonatites that have been explored for potential REE production
 - 6.1. Araxá
 - 6.2. Ashram
 - 6.3. Bear lodge
 - 6.4. Fen (Rødberg)
 - 6.5. Gifford Creek
 - 6.6. Kangankunde
 - 6.7. Lofdal
 - 6.8. Mushgai Khudug
 - 6.9. Ngualla
 - 6.10. Sarfartoq
 - 6.11. Songwe Hill

- 6.12. Tomtor
- 6.13. Wigu Hill
- 6.14. Zandkopsdrift
- 6.15. Amba Dongar

7. Geology of world class REE deposits associated with carbonatites

- 7.1. Mountain Pass
- 7.2. Bayan Obo
- 7.3. Mianning-Dechang REE belt
- 7.4. Miaoya
- 7.5. Weishan
- 7.6. Gakara (Karonge)
- 7.7. Kangankunde
- 7.8. Songwe Hill
- 7.9. Tomtor
- 7.10. Catalao I and Araxa
- 7.11. Bear Lodge
- 7.12. Ashram
- 7.13. Korsnäs
- 7.14. Mount Weld
- 7.15. Mushgai Khudug
- 7.16. Dong Pao
- 7.17. Eureka
- 7.18. Fen (Rødberg)
- 7.19. Lofdal
- 7.20. Ngualla
- 7.21. Sarfartoq
- 7.22. Wigu Hill
- 7.23. Zandkopsdrift

8. Discussion

- 8.1. Economic aspects of various REE resources
 - 8.1.1. Heavy mineral sands (HMS)
 - 8.1.1.1. HMS: positive economic aspects
 - 8.1.1.2. HMS: negative economic aspects
 - 8.1.2. Ion-adsorption clays (IAC)
 - 8.1.2.1. IAC: positive economic aspects
 - 8.1.2.2. IAC: negative economic aspects
 - 8.1.3. Loparite-bearing deposits
 - 8.1.3.1. Loparite: positive economic aspects
 - 8.1.3.2. Loparite: negative economic aspects
 - 8.1.4. Pegmatites
 - 8.1.4.1. Pegmatites: positive economic aspects
 - 8.1.4.2. Pegmatites: negative economic aspects
 - 8.1.5. Silicate-bearing deposits
 - 8.1.5.1. Silicates: positive economic aspects
 - 8.1.5.2. Silicates: negative economic aspects

1. Introduction

8.2. Factors that favor carbonatites for economic REE production

- 8.2.1. Large ore bodies
- 8.2.2. High-grade deposits
- 8.2.3. Favorable minerals
- 8.2.4. By-product production
- 8.2.5. Low radioactivity

9. Conclusions

10. References

Affidit. Similarities and geomodel of REE carbonatites

Summary

REE trace in carbonatites is almost twice as the primary host (Figure 1 and 2). Some of them (La, Ce, Sm, Eu, Tb, and Y) are enriched 10-100 times (La, Ce, Sm, Eu, Tb, and Y) and 10-100 times (La, Ce, Sm, Eu, Tb, and Y).

Carbonatites are rare igneous rocks with high silica and low iron. They are usually enriched in REE because of their enriched rare earth content (La, Ce, Sm, Eu, Tb, and Y) and 10-100 times (La, Ce, Sm, Eu, Tb, and Y) and 10-100 times (La, Ce, Sm, Eu, Tb, and Y).



Figure 1. Locations of major REE deposits in the world, modified after (1) and (2).