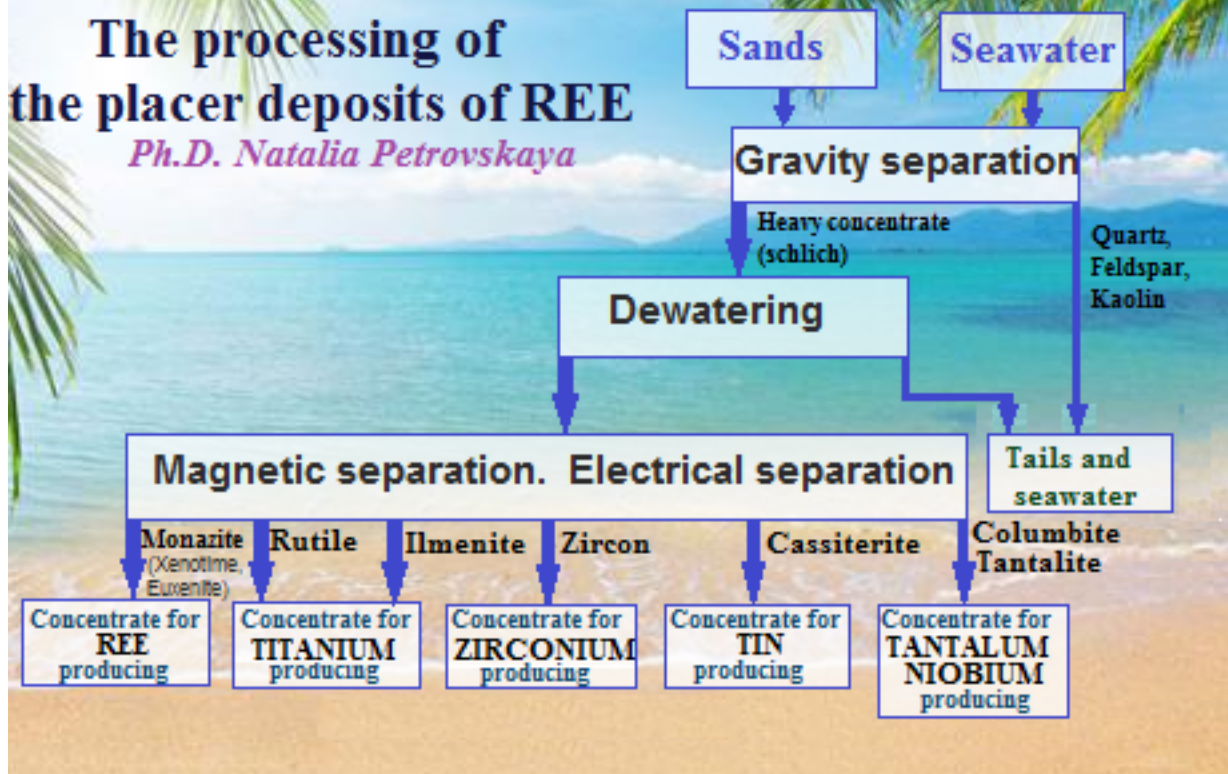


The processing of the placer deposits of REE

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**Placer deposits of ores containing REE
(alluvial deposits)**

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Placer deposits of ores containing REE

Placer deposits of rare earth metals (alluvial deposits) are the coastal sands, which are located along the shores of oceans, seas and rivers. The size of mineral particles is 0,07-0,2 mm (to 1 mm). Placers are occupied from hundreds of meters to tens of kilometers along the coast. The

width of the placers is tens of meters (sometimes hundreds of meters). Seam Thickness is 2 meters (sometimes up to 10 meters).

Placer deposits of rare-earth metals are a traditional source of the REE production. Mining and processing of REE placer deposits are very developed throughout the world.

Today, due to the rapid development of technology, the extraction of marine placers is possible. There are special marine dredges. This is a very important point, because stocks of marine alluvial deposits are very large. In my opinion, the placer deposits can be considered as of the most promising feedstock for obtaining REE.

Marine, coastal-marine and river placers containing REE there are (map):

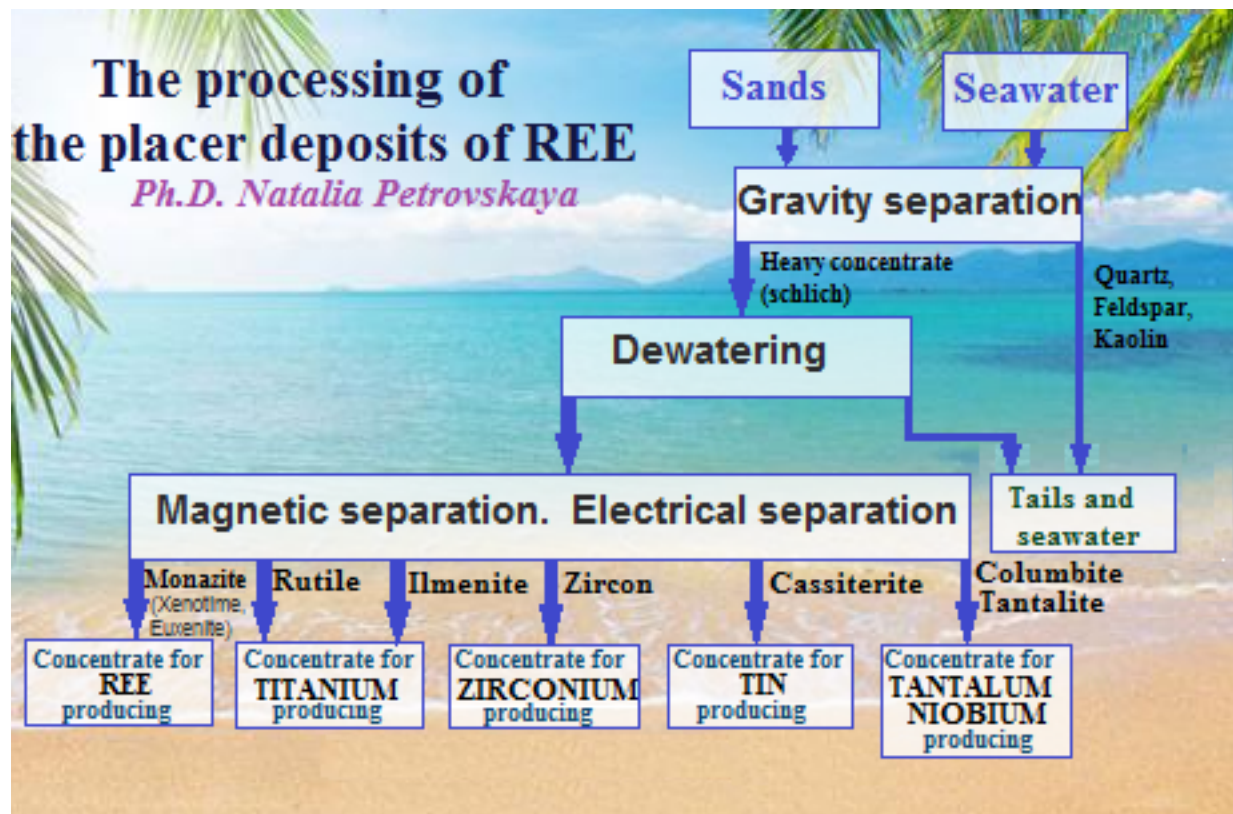
- [Monazite](#) (the monazite sand) in Australia, Brazil, India, the United States (Florida, North Carolina and South Carolina, Idaho, Virginia, Colorado), Malaysia, South Africa, Sri Lanka, Mozambique, Thailand, China, North Korea, Madagascar, Russia, Spain, France, Kazakhstan, Ukraine.
- [Xenotime](#) in Australia, Malaysia, Thailand, Brazil, Russia and China.
- [Euxenite](#) and [fergusonite](#) in the United States (Idaho) and China.
- [Eudialyte](#) in the United States (Idaho).

Placers are the complex raw materials and they contain:

- [Rare earth minerals](#) (mainly [monazite](#), [xenotime](#) and sometimes [euxenite](#))
- [Titanium minerals](#) ([ilmenite](#), [rutile](#) and [leucoxene](#))
- Zirconium minerals ([zircon](#))
- Tin minerals (cassiterite)
- Tantalum and niobium minerals (columbite, tantalite and [euxenite](#)).

To extract minerals from REE placers one can use environmentally friendly and cheaper technologies. Since the placers are small particles, there is no need to apply crushing and grinding.

Current and future processing schemes of placer minerals are included usually several ways of gravity separation of minerals to produce a collective concentrate (schlich, heavy concentrate). The tails of placer minerals don't accumulate. The tails return to the ocean in a secure form (in the same form as the original raw material). Next may be used a combination of advanced methods of wet and dry separation of minerals. The schemes of REE ore processing may be different by sequence of operations depending on the mineral composition of placer. I would not recommend the use of flotation for the separation of REE placers due to the formation of harmful tailings. Today, there are environmentally friendly methods of mineral separation.



The processing of placer deposits of REE has many advantages:

1. Processing of placer deposits of REE is produced by environmentally friendly technology without the use of any chemicals. Virtually no negative impacts on the flora and fauna of the ocean and coastal areas.
2. Processing of placer deposits decreases the radiation background at the shores of seas and oceans. The ecological situation is improving because radioactive minerals are removed from the beaches. Beaches become a beautiful light color.
3. Good working conditions without dust and chemical vapours.
4. Perhaps the complex use of raw materials and the obtaining of several concentrates, which increases profit.
5. The use of cheap technology.
6. Low cost of search and exploration of placer deposits. One deposit can be used for long time. Ocean continuously feeds new portions of raw materials without a limit.
7. There are no the costs for the construction of the quarry or mine.

8. Low construction costs for the processing plant. One floating plant – the marine dredge can be used for 50 years and more at the numerous placer deposits.

9. There are no the costs of crushing and grinding.

10. There are no the waste rock dumps, tailings containing hazardous and radioactive waste. There are no the costs for it.

11. There are no the costs of restoring the site.

12. Fresh water is not used. There are no the costs of preparation and purification of fresh water. Separation is made directly in seawater. Not any chemicals or minerals pollute the seawater.



The processing of placer deposits of REE has the following disadvantages:

1. Relatively low content of REE in placer ores. Recycling is economically viable only with preparation of several concentrates.

2. Relatively small ore reserves in the deposit field in the beach.

3. Some level of radioactivity of the monazite beaches. The basic mineral is monazite, which is due to the present of the radioactive thorium. Monazite sands of India (10% ThO₂), Brazil (5% ThO₂) Sri Lanka (20% ThO₂) are more radioactive then others.

4. Monazite concentrate from placer deposits is also radioactive and requires additional safety measures.

5. Some REE manufacturers have refused to buy the monazite concentrate, since it produces a lot of processing waste with thorium, which requires additional expenditure on storage.

6. Today they use the relatively primitive old technology at the processing of the alluvial REE ores. New equipment can allow obtaining additional concentrates simultaneously with the main, but it is not considered at the development of processing technologies now.

7. As a rule, they get heavy concentrate at the marine dredge, and the rest of the separation is produced on land. It is necessary to build deep-processing mineral plant at the shore (with new equipment and the promising technology, it is not needed).

8. The mining processes are significantly affected by weather conditions (storms, hurricanes and etc.), which complicate the work of the marine dredge or make it impossible at certain season.

9. Relatively small companies are involved at the development of the placer mining and processing; they don't have a full cycle of REE processing. That is, they are produced and sold concentrates instead of metals. Concentrates are much cheaper than metal.

10. Typically, extraction of alluvial REE ores produced in the shallows, where the content of the components is not stable. Today, however, the placer mining is possible from the seabed at a depth large enough (on the shelf), there the content of valuable components is more stable and there are more reserves of ore.

11. There are not a sufficient number of specialists of the processing of alluvial REE deposits.

Development of marine placers are very promising direction. However each placer deposit has its own individual characteristics. Each REE ore must have its own individual technology. It is solution of tomorrow day.

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