Translation of article published May 22, 2017, at:
http://www.deutschlandfunk.de/rohstoffe-in-der-tiefsee-scandium-im-arktischen-ozean-weckt.676.de.html?dram:article_id=386808
(To listen to the radio broadcast, click the box labeled "HÖREN" in the bottom right corner of the photograph.)

Raw materials in the deep sea

Scandium in the Arctic Ocean awakens desires

For a long time, deep-sea mining was a technological fantasy of the future. But today this has changed—partly due to climate change. Economically interesting and rare raw materials are becoming more obtainable—such as scandium in the Arctic Ocean.

Treasure hunt at the Poles (Ulf Mauder / dpa)

By Dagmar Röhrlich

100 years ago, the Arctic Ocean was largely inaccessible to humans, but conditions have changed considerably as a result of climate change. And consequently, exploration of earth's smallest ocean has begun with a view to its natural-resource deposits:

"In the Arctic Ocean, specifically the deep ocean, we have discovered two types of metallic raw materials: On the one hand we find metal-containing sulfur compounds at the mid-ocean ridges between Greenland and Norway and in the Laptev Sea off Siberia. These compounds form on black smokers, which are hot, volcanic springs in the deep sea. On the other hand, iron-and-manganese crusts, which contain many

rare metals of economic interest, are forming off of Alaska on deep-sea rock formations," explains James Hein of the U.S. Geological Survey (USGS) in Santa Cruz.

Scandium is one of the rare-earth elements

The iron-and-manganese crusts in the Arctic Ocean are unique in their composition:

"In contrast to deposits in other deep-sea settings, these crusts are highly enriched in scandium. Scandium is sometimes classified with the rare earth metals, though it is not really rare, but simply doesn't accumulate in deposits. It is obtained as a byproduct in copper mining. Scandium is used, for example, in the construction of light aircraft, for solid oxide fuel cells, expensive aluminum scandium bicycles, or very expensive baseball bats."

In 2008, off the coast of Alaska, the Americans discovered what is currently the only scandium deposit in the world. After several years of research, it has become clear why these deposits occur only in the Arctic Ocean:

"The Arctic Ocean is small and enclosed by land masses, and, compared to its size, it has a tremendous amount of material from erosion and weathering flowing into it, transported by glaciers and rivers. This forms the basis for these unique mineral deposits."

Eroded materials from the land are deposited on the seabed

The eroded materials from the land contain metals such as iron, manganese, tungsten, cobalt, zinc—and scandium. On the seabed, these metals are released from the sediments over time. They get into the water, and currents distribute them in the deep sea:

"All the metals are precipitating out of the cold deep water: they coat the rocks as crusts, and because a great deal of scandium is dissolved in the water, it also accumulates in these crusts. There is also a second mechanism: the iron-manganese crusts in the Arctic Ocean contain an unusually high amount of eroded materials—up to 35 percent—and because these materials happen to be rich in scandium, they contribute to the enrichment of scandium in these deposits."

However, it is currently unclear whether mining with deep-sea robots in 1,600 to 3,000 meters water depth is economical, says James Hein:

"To form the metal crusts, the deep water must be oxygen-rich. This has been the case in the Arctic Ocean only for 14 or 15 million years, since plate tectonics opened up a deep passage to the Atlantic. That is why iron-and-manganese crusts in the Arctic Ocean are at most 8 centimeters thick, while they can reach up to 25 centimeters in the Pacific, where the process has been going on for 70 million years."

Should mining become economically interesting, scandium would likely be its focus. [Actually, if mining were to occur in the Arctic Ocean, several metals would be extracted from the ore.] However, samples collected so far are from rough, steep terrain with great differences in relief. Such terrain is unlikely to be suitable for the use of mining robots. On the other hand, the deep sea off Alaska has barely been explored, so there might be surprises. The Russians, have in the meantime, confirmed the discovery of scandium-containing manganese-iron crusts in their territory.