

## What's the World's Most Common Mineral?

What's the most common mineral in the world? Most would answer "quartz", but as one might suspect, it's a bit of a trick question.

Quartz is indeed a common mineral, found in sandstone, gneiss, quartzite, and chert, to say nothing of hydrothermal vein quartz. Authors of basic geology texts frequently describe continental crust's composition as equivalent to quartz-rich granite. This includes granitic rock per se, weathered granitic rock, granitic rock redeposited as sediment, and metamorphosed granitic rock. Granitic rocks generally contain from 20 – 40% quartz, with a median value of perhaps 33% quartz. If we consider continents as blobs of granitic rock covering 40% of the earth and averaging 45 km. thick, we can calculate that the continents contain about 3.0 billion cubic kilometers of quartz.

However, 60% of the crust consists of ocean crust. This consists mostly of basalt and gabbro in which quartz is rare. The most common mineral (actually a series of compositionally related minerals) in these rocks is plagioclase feldspar. Plagioclase usually makes up about 60% by volume in these rocks. Oceanic crust averages 8 km. thick. Plagioclase also occurs in granitic rocks, where it forms 20-60% of the rock. Lower in the crust it probably makes up a larger volume, but let's go with plagioclase making up 40% of typical continental crust. If we calculate the volume of plagioclase in continental and oceanic crust combined we get about 5.1 billion cubic kilometers of plagioclase feldspar, nearly twice the quantity of quartz.

But the crust makes up only a small amount of the Earth. A lot of the Earth is an iron-rich core 3,470 km. thick. If it were all solid, we'd have 175 billion cubic kilometers of iron-nickel alloy. The outer core is liquid, so isn't a mineral (give the earth another few billion years to cool more). That still leaves us with an inner solid core 1100 km. thick. This gives us about 5.6 billion cubic kilometers of iron-nickel alloy. Is iron-nickel alloy then the most common mineral on earth? We are assuming it forms just a single mineral phase. We are also neglecting the earth's mantle, which makes up most of our planet's volume.

Quartz and iron-nickel alloy are rare in the mantle. Plagioclase also breaks down to other minerals such as garnet under the high pressures there. Even heat - hearty minerals such as olivine and pyroxene change. About 660 km. deep in the mantle is a major transition zone below which many familiar minerals change to new minerals having a "perovskite-type structure". Perovskite is a rare calcium, titanium oxide found in the crust found in rocks such as syenite, carbonatite and marble. Its atomic structure is quite

resistant to pressure. The minerals found deep in the mantle are not the same chemically as perovskite but they have the same atomic structure. They don't have their own names, as they haven't been actually found yet in natural rocks. Their presence in the mantle is strongly indicated on theoretical and experimental grounds. These perovskite-type minerals would dominate the earth between depths of 660 km and 2900 km. That makes up a volume of 600 billion cubic kilometers. Should any of them make up as little as 1% of the mantle, it still would be more common than quartz, plagioclase or iron-nickel alloy. So – TA-DA - the most common mineral on Earth is an un-named mantle mineral with a structure similar to a rare crustal mineral and which no one has ever seen, much less collected.

These are “back of the envelope” calculations, but do point out that we are crustal chauvinists in the way we look at our planet. In fact, we are actually continental crust chauvinists. Our perceptions of our world continue to change as we learn more about the parts that hidden from our view.

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#### References:

Chernikoff, S and Whitney, Donna, Geology, 3rd Edition, Houghton-Mifflin, New York.

Lay, T. and Williams, Q., Nov., 1998, “Dynamics of the Earth's Interior”, Geotimes, p. 26- 30