WHY DO SUCH LARGE CRYSTALS FORM IN PEGMATITES?

Everyone who sees a pegmatite in the field marvels at the gigantic crystals found in them. It's exciting seeing schorl crystals several feet long or picking up large muscovite books. How do such giant crystals form? Most people guess that the large crystals must reflect some unusually slow cooling rate. They would be only partly correct. Pegmatites do form where magmas cool relatively slowly within the earth compared to the fast cooling they would experience if they had erupted on to the earths surface. But pegmatites are associated both in time and space with other igneous rocks that formed at the same depth and show much smaller grains. It should also be noted that large crystals can grow in the lab in the space of days or weeks. There must be something other than slow cooling to explain these giant crystals.

The solution came as a result of work done by two geologists, Richard Jahns and Wayne Burnham, who had seen a lot of pegmatites while scouting them for strategic metal resources during World War II. Later they conducted experiments with artificial granite magmas and discovered that the key factor seemed to be the presence of lots of gases (or, to give them a more technical name, volatiles) such as water, fluorine, or chlorine dissolved in the magma These volatiles have several effects on the magma which make it possible to form pegmatites.

First the volatiles make it more difficult for crystals to form in the first place. That means that there are fewer crystals growing in the magma at any one time, so they can grow bigger without interfering with each other. Second, granite magma is usually a thick sticky liquid, but the more volatiles it contains, the less thick and viscous it is and the easier it is for chemicals to move from place to place. That supplies the growing crystals with the chemicals needed to grow larger. Third there are enough volatiles the magma will eventually get so saturated in them, the volatiles will separate as watery bubbles surrounded by normal liquid magma. Crystals may grow simultaneously from both the liquid and the gas bubbles, with the larger ones forming from the bubbles. Thus it is really the presence of gases that make the growth of the large crystals possible.

What happens to these volatiles? If they stay in the pegmatite, eventually they form fluorine, chlorine or water-bearing minerals as the magma finally cools off. In other cases, they might escape from the magma. Pegmatites are often filled with broken and rehealed crystals that may have been broken by progressive sudden releases of some of the volatiles. Some pegmatites grade into much finer-grained granites called "aplites" which could be formed if a magma suddenly loses all of its volatiles and forms only small crystals afterwards.

So the next time you see a pegmatite, Just remember that you have the gas to thank for all those beautiful giant crystals.

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