Xenolith Encyclopedia Article

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Xenolith

A xenolith is a **rock** fragment embedded in, and distinct in texture and composition from, a surrounding mass of igneous rock. Xenoliths form when rising **magma** forces its way through channels and cracks, tearing off fragments of their walls and incorporating them into rising magma. These inclusions are termed xenoliths if they did not form from the magma itself, autoliths, or cognate xenoliths, if they were first solidified along the channel walls from the rising magma and re-incorporated later. Single large **crystals** included in igneous rock by the same means as xenoliths are xenocrysts. Xenoliths, which are named from the Greek *xeno* (foreign) and *lith* (rock), typically range from sand-grain size to football size.

When first captured by magma, a xenolith both cools and is heated by the liquid rock around it. How altered it is by heating depends on its size and original **temperature**, on the temperature of its magma bath, and on the proximity of other sources of heating or cooling. If a xenolith is rapidly cooled after capture, its **chemistry** and mineral structure will change little; if it is partly melted before being finally cooled it will undergo some degree of metamorphosis; and if it is thoroughly melted it will blend with the surrounding magma to produce a hybrid or contaminated igneous rock.

Xenoliths may be captured by magma near the surface or deep in the mantle. If mantle-derived xenoliths are carried to the surface rapidly enough to avoid significant metamorphosis they convey valuable data from the depths. For example, some mantle-derived xenoliths consist of a combination of the **minerals olivine**, pyroxene, and garnet. Laboratory **melting** experiments show that the **aluminum** and magnesium content of a pyroxene crystallized in the presence of olivine and garnet depends uniquely on both pressure and temperature. Chemical analysis of an unmetamorphosed mantle-derived xenolith thus reveals the pressure (dependent on depth) and temperature at which it crystallized, giving a temperature reading for a specific depth. Xenoliths can originate hundreds of kilometers underground, far below the reach of the deepest mining or drilling operations, so this data is otherwise unobtainable. Pristine xenoliths also reveal rock textures and compositions deep in the mantle.

See Also

Country Rock; Crater, Volcanic; Dike; Hotspots; Magma Chamber; Metamorphic Rock; Metamorphism; Sill; Volcanic Eruptions; Volcanic Vent