Intrusive Cooling Encyclopedia Article

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Intrusive Cooling

Igneous rocks formed below ground level are termed intrusive, meaning that they originate as **magma** (liquid **rock**) that has intruded itself into preexisting solid rock by squeezing into cracks, eating its way upward from the mantle, or by other means. An intrusive magmatic body begins to cool as soon as it is emplaced, and as it cools, it crystallizes into a mixed mass of mineral grains. Which **minerals** form depends in a complex way on the exact ingredients of the magma and on the speed at which it is cooled. In general, slow cooling permits larger **crystals** to form while fast cooling produces smaller crystals.

Cooling is affected by shape and other factors. Thin or narrow bodies cool faster than globular ones; small bodies cool faster than large ones; convecting bodies cool faster than static (nonconvecting) ones; and bodies surrounded by relatively low-temperature rock cool faster than those emplaced in warm environments. By human standards, cooling time for intruded magma may be quite long. A horizontal, sheet-shaped intrusion of 1,562°F (850°C) magma 2,300 ft (701 m) thick, intruded beneath a cool 77–122°F (25–50°C) cover of rock half as thick, takes 9,000 years to completely crystallize. A vertical sheet of 1,472°F (800°C) magma 6,560 ft (2,000 m) thick emplaced in 212°F (100°C) rock takes 64,000 years to crystallize all through. The largest magmatic intrusions may take a million years to crystallize.

Near-surface intrusive cooling may be speeded by convection of **groundwater** through surrounding rock. In this case, **water** may transport minerals toward and away from the cooling intrusion, further complicating the process of mineral formation.

See Also

Batholith; Bowen's Reaction Series; Extrusive Cooling; Pluton and Plutonic Bodies