a11 Rocks < 3 origins, hybrid varieties >

> The best geologist is he who has seen the most geology. —Herbert Harold Read (1889–1970).[1]
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> In contradiction to petrological arguments by Norman Bowen and Frank Tuttle for an igneous origin of (most) granite [2] he favored from field evidence that "It may be that it is only by the grace of granitization [metasomatism of sediments and basalts] that we have [granitic] continents to live on."[3]
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> There is often so insensible a passage from a soft and incoherent state to that of stone, that geologists of all countries have found it indispensable to have one technical term to include both, and in this sense we find ROCHE applied in French, ROCCA in Italian, and FELSART in German. The beginner, however, must constantly bear [have] in mind that the term rock by no means implies that a mineral mass is in an indurated or stony condition.
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> The most natural and convenient mode of classifying the various rocks which compose the earth's crust, is to refer, in the first place, to their origin, and in the second to their relative age.
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> —James Geikie, 1874.[4]

Three types of rocks can be distinguished by their different origins.[5] These are:

Igneous rock is a crystalline granular or glassy mass solidified from a formerly molten, or partly molten, state. Solidification can be the result of cooling, loss of fluids, or chemical reactions with the country rock. Igneous rocks make up most of the volume of Earth's crust.

Sedimentary rock consists of accumulated materials (sediments) derived from other rocks and deposited after transportation (by mass wasting, running water, wind, or glacial ice). Lithification (turning to stone) of sediments (a rock of loose, unconsolidated, particulate matter) to sedimentary rock (a rock of consolidated particulate matter) is post depositional and involves variously compaction, cementing, and partial recrystallization. Sediments and sedimentary rocks crop out extensively (in area, they cover two thirds of the continents and almost all of the seafloor).

Metamorphic rock is recrystallized, previously existing, rock. Recrystallization is without melting and results from a change in ambient pressure and/or temperature. Chemically active fluids in, or passing through, can catalyze or reactively cause recrystallization. If the recrystallized rock has the same chemical composition as the original rock it is called *metamorphic rock*. If there is evidence of a bulk chemical change, then the recrystallized rock is called *metasomatic rock*.

Rocks that have combinations of the three above origins are hybrids. For these, an historical description of their provenance (origin with reference to place and circumstances) can be given in terms of the three rock types: igneous, sedimentary, and metamorphic. For example, tephra is both igneous and sedimentary, metasediments are both sedimentary and metamorphic, metavolcanics, also migmatites, are both igneous and metamorphic, and impact fallout-breccia can be of all three (glassy, detrital, and shocked). The study of rocks—their occurrence, structure, mineral composition, chemical composition, classification, origin (history of formation), and alteration—is called *petrology* (Gk. *petros*, a stone; *petra*, rock).[6]

The suffix *-ite* (Gk. *-ites*) denotes a mineral or a rock. ❑

Author's note:

In this book, all triangular (ternary) plots of A, B, and C, where these are the amounts of each in a sample, are redrawn to be orthogonal in the plot of the two percentage variables:

$x = 100*A/(A+B+C), \quad y = 100*B/(A+B+C).$

In the plane (x, y), $z = 100-(x+y)$.