

were made to separate from them any mineral elements which were foreign to the rock, or had come into the magma before it solidified, and also all secondary elements which had formed after the consolidation of the rock during the processes of internal decomposition or interaction.

Excellent work has been done in this field of research by Roth, Bischof, Delesse, Zirkel, Broegger, and Iddings.

Certain principles are usually inculcated regarding the sequence in which the minerals take origin during the passage of a magma from the viscous to the solid state, but the principles are by no means always applicable, and have therefore frequently been contested. Minerals which have crystallised with the most complete and perfect form have usually been regarded as the first-formed, while those which appear to have been checked in their proper development by others, have been regarded as of later formation. Again, minerals that are enclosed within other minerals are usually taken to be older than the enveloping material, yet cases are cited where they are really younger, having separated out from a portion of the magma enclosed within the developing mineral. Minerals without any inclusions for the most part belong to the first generation of solid material. If two minerals occur as intergrowths with one another, contemporaneous generation is indicated. In rocks with porphyritic structure the larger mineral forms are as a rule older than the ground-mass.

It was in accordance with these principles that Fouqué and Michel-Lévy first distinguished different generations of minerals, and used the number of the mineral generations as a distinguishing feature between rocks of granitic and porphyritic structure. Through a large number of individual observations it has been possible to determine genetic series for the rock-forming minerals. Certain minerals, such as magnetite, titanite, rutile, apatite, zircon, spinel, olivine, belong generally to the earliest products of separation, preceding the augites, hornblendes, feldspars, and quartz. Rosenbusch holds the opinion that in the deep-seated rocks, at any one interval of time, there is only one kind of mineral separated from the magma. The periods of formation for the different constituents succeed each other so that either those of one kind do not form until the complete separation of the preceding kind; or much more frequently, a younger constituent in order of separation begins to form a certain time before the completion of the