

A SUGGESTION FOR THE TERMINOLOGY OF CERTAIN MINERAL DEPOSITS.

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A number of years ago I suggested that the ores which have been deposited by hot ascending waters fall naturally in three classes dependent upon the physical conditions surrounding their genesis.² Later on, this mode of subdivision was introduced in a textbook on "Mineral Deposits"³ and it has since been adopted by other authors.⁴ It was recognized from the start that the various classes were not sharply defined but gradually merged. On the other hand, the principle of classification seemed the only one suitable for a genetic system. It was also evident that the classification lacked a concise terminology and critics have not failed to emphasize this. While it seemed inexpedient to introduce new terms until the underlying principle was vindicated, the time for this introduction would seem to have arrived now, if acceptable names can be provided.

The general classification outlined in the work referred to has also been subjected to some criticism⁵ on account of its alleged lack of strictly logical categories. This criticism may be well founded, but in the present state of our knowledge such a strictly logical system would be quite useless. There must be some elasticity, and exact definitions would only poorly veil our lack of knowledge as to the genesis of many deposits.

The terminology proposed would substitute definite terms for long descriptive statements and briefly stated would be as follows:

DEPOSITS OF ORIGIN DEPENDENT UPON THE ERUPTION OF IGNEOUS ROCKS.

A. *Hydrothermal Deposits.*

- a. Epithermal. Formed by ascending hot waters near the surface in or near effusive rocks at relatively low temperature and pressure.

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² 10th Cong. Geol. Internat. Mexico, Pt. 2, 1906.

³ Lindgren, W., "Mineral Deposits," New York, 1913.

⁴ Ries, H., "Economic Geology," New York, 1916. Emmons, W. H., "Principles of Economic Geology," New York, 1918.

⁵ Crook, T., *Min. Mag.*, London, vol. 17, 1914, pp. 55-85.

- b. Mesothermal. Formed by ascending hot waters in or near intrusive rocks at intermediate temperature and pressure.
- c. Hypothermal. Formed by ascending hot water in or near intrusive rocks at high temperature and pressure.
- B. *Emanation Deposits.*
- a. Sublimates. Formed by igneous emanations in effusive rocks near or at the surface at high temperature and low pressure.
- b. Exudation Veins. Small local veins in effusive rocks formed by igneous emanations at high temperature and low pressure, *e.g.*, tin veins in rhyolite.
(surface type)
- c. Pyrometasomatic Deposits. Equivalent to "contact metamorphic" deposits. Formed by metasomatic changes in rocks, principally in limestone, at or near intrusive contacts, under influence of magmatic emanations, Temperature and pressure high.
- d. Exudation Veins. Small local veins in intrusives. Formed by direct emanations at high temperature and pressure. Connects by transitions with hypothermal veins.
(Deep seated type)
- C. *Magmatic Deposits.*
- a. Orthotectic.⁶ Genesis by direct magmatic processes. Differentiated product poor in mineralizing fluids.
1. Differentiated in situ, *e.g.*, chromite deposits.
 2. Injected, *e.g.*, dikes of magnetic or ilmenite.
- b. Pneumotectic.⁶ The differentiated fluid is rich in mineralizers.
1. Differentiated in situ. An uncommon type.
 2. Injected. Exemplified by pegmatite dikes and by injected sulphide deposits. Sudbury would probably fit in here. These deposits form transitions to the hypothermal veins.

The terms epithermal, mesothermal and hypothermal are in close analogy with Grubenmann's three metamorphic zones, but do not exactly correspond to them. The prefix "hypo" has been substituted for "kata" to correspond with Ransome's now generally accepted terms of "hypogene waters," the suggestion implied being that the hypogene waters are principally derived from

⁶ The terms "orthotectic" and "pneumotectic" have recently been proposed by L. C. Graton and D. H. McLaughlin, *ECON. GEOL.*, vol. 13, p. 85, 1918.

the region of the hypothermal deposits. It is not desired to imply that such waters are necessarily wholly of magmatic origin.¹

It is important to note that the hypothermal deposits form the transition link towards the deep-seated emanation deposits and towards those of the magmatic type.

In regard to these hypothermal deposits it should be emphasized that temperature is the dominating factor, though it is nearly always accompanied by high pressures. A deposit is of high temperature origin if noteworthy quantities of any of the following minerals occur in it: Pyrrhotite, magnetite, spinel, soda-lime feldspars, amphibole, pyroxene, biotite, topaz, tourmaline, axinite and garnet. Epidote and specularite generally, but not always, indicate such origin. The absence of the minerals enumerated does not positively indicate a lower temperature, for only persistent minerals like pyrite, chalcopyrite and quartz might be present. Usually some of the high temperature minerals are present in the altered wall rock at least.

Many mineral deposits have been altered by other agencies since their original formation. Such might be referred to as re-worked deposits. An incomplete list of these would include:

- A. *Metamorphic Deposits*. Altered by processes of metamorphism.
- a. *Dynamometamorphic Deposits*. Altered by deformation. New minerals formed in part.
- b. *Pyrometamorphic Deposits*. Altered by contact metamorphism but without introduction of new substance. *e.g.*, a sedimentary limonite deposit altered to magnetite.
- B. *Supergene Deposits*. Old deposits altered by descending surface waters. Often two zones may be distinguished in these which may be called, respectively, the *oxysupergene* and the *sulphosupergene* zone according to whether oxysalts or supergene sulphides predominate.

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¹A new nomenclature has quite recently been proposed by P. Niggli (Schweiz. M. & P. Mitt., Vol. 1, pp. 392-408) based in part on Bergeat's terms "peri-magmatic" (contact metamorphic) and "apo-magmatic" (ascending magmatic waters). While recognizing the value of these terms, I prefer not to use them, owing to the difficulty of recognizing what is "apo-magmatic" and what is not.