

DIASPORE OCCURRENCES AT QUADRILATERO FERRIFERO, MINAS GERAIS-BRAZIL

PIRES, F.R.M.^{(1)*}, MIANO, S.C.^{(2)**} & LIMA, E.M.^{(1)***}

⁽¹⁾ UFRJ - Departamento de Geologia - Ilha do Fundão, Rio de Janeiro, RJ, 21949-900

⁽²⁾ UFF - Pós-Graduação em Geoquímica - Outeiro de São João Batista, Niterói, RJ, 24210-007

⁽³⁾ EMBRAPA - CNPS, Setor de Mineralogia e Micromorfologia - Jd. Botânico, Rio de Janeiro, 22460-000

* frpires@igeo.ufrj.br, **geoscm@vm.uff.br, ***edia@cnpes.embrapa.br

ABSTRACT

The paper describes the physical and crystallographic characteristics of diaspore that occurs in the Quadrilatero Ferrifero, Brazil. With this purpose it presents a brief comment on the occurrences, mineral assemblage and geologic features of some deposits of diaspore found in the world. Thirteen phase equilibrium reactions are presented and discussed on the basis of T, P, SiO₂ dependence and μH₂O.

Key-words: Diaspore, Hydrothermal, Chemical Potencial, Quadrilatero Ferrifero

GENERAL COMMENTS

Diaspore occurrences are not common in the Quadrilatero Ferrifero (QF). In the bauxite deposits of the QF gibbsite is the only Al hydroxide found. Although the colloform gibbsite occurrence at Gamba is very famous, it is difficult to find good specimens in that site. Diaspore occurs in decametric, lenticular hydrothermal veins associated with pyrophyllite, talc and rutile in the pavement of an old roadway linking the Capao do Lana topaz mine and the abandoned Bohrer topaz deposit (Fig. 1). It appears as greyish white, translucent, dense crystals with vitreous to pearly luster exhibiting the pronounced (010) cleavage. Diaspore crystals are up to 3 cm in size, as isolate specimens, which may be found scattered on the surficial part of the outcrops as well as in the surrounding discrete stream drainages. It was identified through optical and X-rays diffraction methods. Nevertheless diaspore occurs more commonly in bauxite and emery deposits, such as Chester (Massachusetts, USA) and Naxos (Greece), and subordinately in dolomitic marbles, as Campolongo (Switzerland) may also be found as one of the products of hydrothermal alteration of aluminous silicates (andalusite, kyanite, pyrophyllite, etc.). It may rarely be encountered in schists, as the chlorite schists at Mramorskoi (Urals, Russia).

It may represent the result of moderate to advanced stages of dehydration of gibbsitic or boehmitic bauxites under metamorphism. It may consist of an intermediate stage in the formation of corundum during the metamorphism of gibbsite from bauxites, under amphibolite facies conditions. In the case of hydrothermal alteration of Al-silicates acid conditions must prevail in order to remove the silica as H₄SiO₄. We argue whether the surficial conditions are able to transform the referred Al-silicates into diaspore.

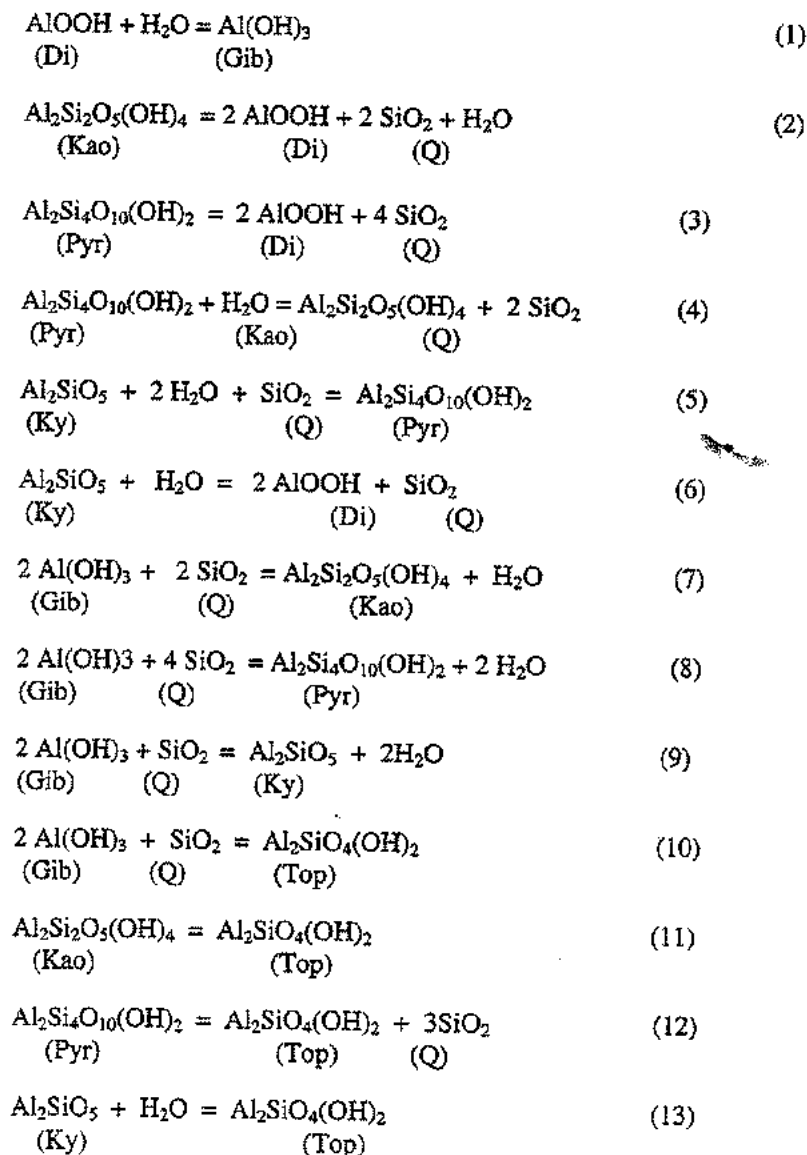
DISCUSSION AND CONCLUSIONS

Pyrophyllite, and perhaps kyanite and kaolinite occur along with diaspore, in the quartz-kyanite-specular hematite and topaz-kaolinite-hematite-euclase veins in the neighbourhoods of the study area (Pires & Neves, 1985), we are able to use the mentioned phases in order construct chemical potential diagrams for silica and water according to the phase equilibria in the system Al₂O₃-SiO₂-H₂O. Diaspore, pyrophyllite, kyanite and kaolinite are the phases in stable, or meta-stable equilibrium with the prevailing metasomatic hydrothermal conditions.

Thirteen low variance reactions can thus be written involving those phases plus gibbsite.

The three component system can be topologically arranged, using the seven existent phases, according to the possible low variance reactions (Table 1). Presence of gibbsite is questionable, because the prevailing metamorphic and hydrothermal conditions disfavored its stability. Diaspore presence is controlled by the existence of silica in the system. Its abundance indicate a silica-deficient ambient and kyanite may be deposited from higher temperature hydrothermal fluids with low $\mu\text{H}_2\text{O}$ and restricted μSiO_2 -conditions (Fig. 2A).

Table 1 - Key reactions in the system Al_2O_3 - SiO_2 - H_2O



Abbreviations: Di = Diaspore ; Kao = Kaolinite; Gib = Gibbsite; Pyr= Pyrophyllite; Ky= Kyanite; Top = Topaz; Q = Quartz.

Under moderate conditions of μSiO_2 and $\mu\text{H}_2\text{O}$ topaz will be the stable phase. The apparent non-coexistence of topaz and kyanite may indicate lower temperatures than the

required to form kyanite in the topaz deposits. On the other hand, f_{HF} was higher enough to prevent the deposition of kyanite in the topaz-rich veins, resulting in the deposition of F-topaz. It is well known that topaz admits 30 mole% maximum of hydroxyl topaz in the molecule. Nevertheless, this endmember has been used in the reactions.

Kaolinite-topaz assemblage is relatively common, consequently most of the reactions took place in the μH_2O -rich side of the "topaz trapezoid" (Fig. 2B). In topaz-free assemblages, either diaspore-pyrophyllite pair or diaspore-pyrophyllite±kyanite±kaolinite would be favored, depending on the behavior of the system in terms of μH_2O or temperature (Figs. 2C and 2D). Gibbsite absence supports the idea that the reactions took place in relatively low μH_2O and higher temperatures in silica-deficient conditions. Gibbsite is stable only below 130°C regardless of pressure and it is converted to diaspore at 300°C, (Ervin & Osborn, 1951) approximately, or around 250°C (Kennedy, 1959). On heating to 450°C, total dehydration of diaspore to corundum occurs (Francombe & Rooksby, 1959), being decomposed slowly between 310°C and 450°C (Ervin & Osborn, 1951). Diaspore may be converted into pyrophyllite under the activity of hydrothermal fluids carrying out silica (Hemley et al., 1980).

The phase equilibria explicated in the μH_2O - μSiO_2 diagrams (Korzhinskii, 1959; Zen, 1966) demonstrate that the chemical potential diagrams are useful to analyse a system without the need of other variables, such as temperature and pressure. Compositional variations may also define the phase equilibria in a system, according to the estimate and relative temperatures.

REFERENCES

- ERVIN, G. & OSBORN, E.F. (1951) The system Al_2O_3 - H_2O . *J. Geol.*, **59**: 381-394.
- FRANCOMBE, M.H. & ROOKSBY, H.P. (1959) Structure transformations effected by the dehydration of diaspore, goethite and δ ferric oxide. *Clay Min., Bull.* 4: 1-17.
- HEMLEY, J.J., MONTOYA, J.W., MARINENKO, J.W. AND LUCE, R.W., (1980) Equilibria in the system Al_2O_3 - SiO_2 - H_2O and some general implications for Alteration/Mineralization Processes. *Econ. Geol.*, **75**: 210-228.
- KENNEDY, G.C. (1959) Phase relations in the system Al_2O_3 - H_2O at high temperatures and pressures. *Am. J. Sci.*, **257**: 563-587.
- KORZHINSKII, D.S. (1959) Physicochemical basis of the analysis of the paragenesis of minerals. (English translation). N.Y., Consultant Bureau, Inc., 172 p.
- PIRES, F.R.M. & NEVES, M.T. (1985) Genese dos Depositos de Cianita do Distrito de Ouro Preto, QF, Minas Gerais. III Simp. Geol. de Minas Gerais, **5**: 251-263.
- ZEN, E-AN (1966) Some topological relationships in multisystems of $n+3$ phases. 1. General theory: unary and binary systems: *Amer. J. Sci.*, **264**: 401-427.

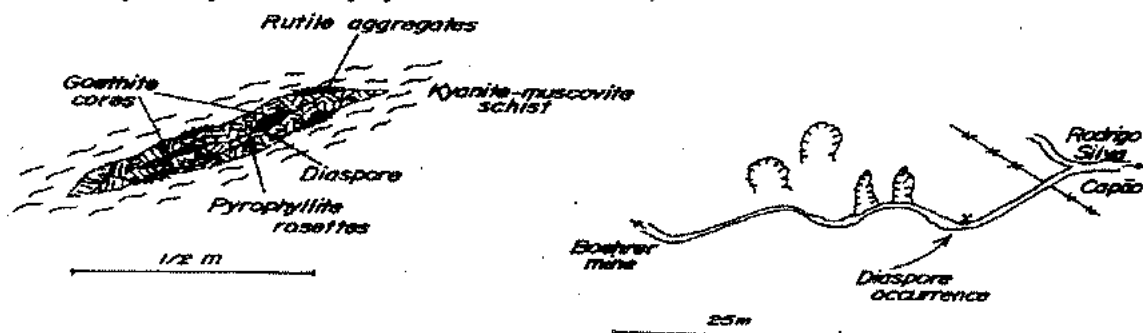


Fig. 1-Diaspore location and occurrence

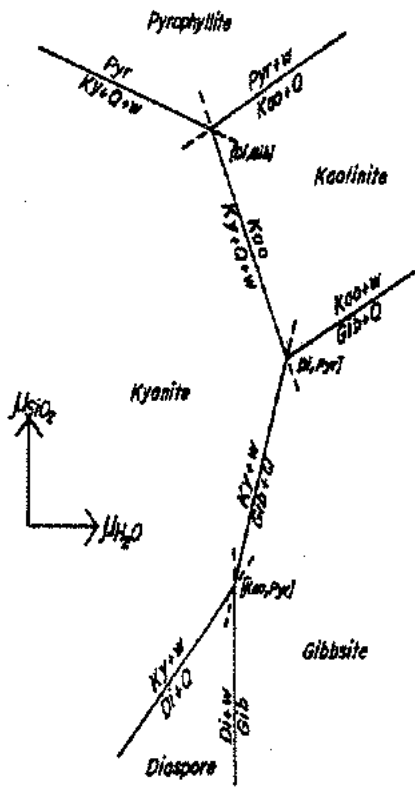


Fig.2C-Kyanite-rich assemblages

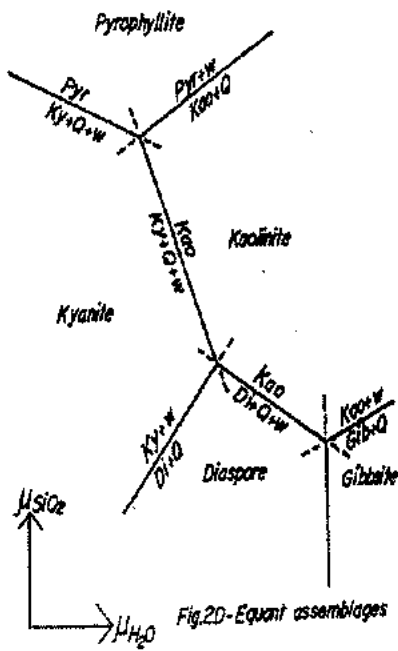


Fig.2D-Equant assemblages