

# GEOLOGY AND SUBSTANCE COMPOSITION OF THE COCITES OF NORTH VIETNAM

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Cocites were distinguished for the first time by A.Lacroix (1933) as a unique variety of ultrapotassic basic rocks of North Vietnam. Later their samples preserved in A.Lacroix's collection were analyzed by C.Wagner and D.Velde (1986), R.H.Mitchell and S.K.Bergman (1991) in connection with the problem of lamproites. Data on the geologic setting and substance composition of these rocks is very scarce and fragmentary. We managed to essentially broaden these data.

## 1. Geology and age

The region of occurrence of cocites is situated in the North- Vietnam folded area which divides the South China and Indochina platform blocks. We have established three areas of cocite occurrence in the northwestern part of the conjugation zone of Shong Da and Fan Si Pan structures within the developing Paleogene complex Pu Sam Cap:

1) series of dike-like bodies among Paleogene alkaline granosyenites and syenites of the left side of the Nam Hon River, 2) autonomous isometric intrusive in the region of the village Coc Pia, which intrudes the limestones of the Dong Sao suite ( $T_2$ ), 3) small isometric dike-like bodies in the field of Paleogene alkaline volcanites of the Pu Sam Cap complex near village Sin Cao (Fig. 1). Isotope datings obtained in the Laboratory of radiogenic and stable isotopes of the UIGGM on cocites of the Nam Hon area suggest their Paleogene age. Monomineral isochron plotted on the basis of analysis of phlogopite fractions by Rb-Sr method showed  $42.3 \pm 7$  Ma at  $(^{87}\text{Sr}/^{86}\text{Sr})_t = 0.70699 \pm 4$ .

## 2. Petrography

Cocites are typically porphyry phlogopite-bearing olivine-pyroxene-K-feldspar rocks. The phenocrysts in them are represented by olivine, pyroxene, and phlogopite. Microprismatically-grained or microlitic groundmass is composed mainly of potassic and sodium-potassic feldspar, and sometimes of brownish interstitial glass also of feldspathic composition with various ratios of K and Na. Some samples exhibit rounded or faceted grains of replaced leucite, microphenocrysts of pyroxene, and phlogopite.

### 3. Mineralogy

Olivine is characterized by a high magnesian content ( $\text{Fo}_{91.1}\text{-Fo}_{82.5}$  are large phenocrysts,  $\text{Fo}_{84.4}\text{-Fo}_{82.5}$  - smaller phenocrysts), has negligible amounts of NiO (0.1-0.3 wt.%) and CaO (0.1-0.2 %), and contains small inclusions of chromites. Pyroxenes, which are compositionally correspond to diopsides, are represented by three types. Large phenocrysts (type 1) are characterized by high magnesian content ( $100 \text{ xMg}/(\text{Mg}+\text{Fe}) = 84\text{-}94$  % at. quantity), elevated contents of  $\text{Cr}_2\text{O}_3$  (0.32-0.98 wt.%), relatively low  $\text{TiO}_2$  (0.1-0.35 %) and  $\text{Al}_2\text{O}_3$  (0.17-1.31 %). In terms of these properties they correspond to pyroxenes of lamproite family. In finely-crystallized groundmass of porphyry cocites with K-feldspar phenocrysts, pyroxenes (type 2) were found which are characterized by rather high contents of  $\text{TiO}_2$  (0.4-0.7) and  $\text{Na}_2\text{O}$  (1.0-3.7), low magnesian content ( $100 \text{ xMg}/(\text{Mg}+\text{Fe}) = 48\text{-}63$  % at quantity) and low concentrations of  $\text{Cr}_2\text{O}_3$  (0.0-0.06 %). Pyroxenes of type 3 have an intermediate composition. One of pyroxene grains exhibited the presence of melt inclusion which is compositionally similar to lamproite magmas ( $\text{SiO}_2 = 41.6$ ,  $\text{TiO}_2 = 1.0$ ,  $\text{Al}_2\text{O}_3 = 9.8$ ,  $\text{FeO} = 5.9$ ,  $\text{MgO} = 20.4$ ,  $\text{CaO} = 6.0$ ,  $\text{Na}_2\text{O} = 0.8$ ,  $\text{K}_2\text{O} = 5.6$ ,  $\text{BaO} = 0.30$ , and  $\text{Cr}_2\text{O}_3 = 0.37$  wt. %). Phlogopites are low-alumina ( $\text{Al}_2\text{O}_3 = 12.3\text{-}14.2$  wt.%) and according to the contents of  $\text{TiO}_2$  and  $\text{Cr}_2\text{O}_3$  are divided into three groups. The first group consists of phlogopites with high contents of  $\text{TiO}_2$  (2.6-7.46 %) and low  $\text{Cr}_2\text{O}_3$  (0.03-0.18 %). The phlogopites of the second group are, on the contrary, characterized by low contents of  $\text{TiO}_2$  (0.97-1.02) and high contents of  $\text{Cr}_2\text{O}_3$  (1.48-1.94). They were found in the cores of large phenocrysts of porphyry cocites of the Nam Hon area. Phlogopites of the third group have intermediate composition. When estimating other mineralogical features of the cocites of North Vietnam, we should mention that they do not contain minerals "prohibited" for lamproites: plagioclase, melilite, monticellite, calcilite. Such minerals as K-richterite and titanium- and zircon-rich oxides: priderite, wadeite, and perovskite, typical of the family of these rocks, have not been yet found in them either. The elucidated variability of the composition of rock-forming minerals indicates a complicated genesis of cocites, which were most likely generated due to contaminated lamproite magma, or as a result of mixing of melts of lamproite and syenite compositions.

### 4. Geochemistry

In terms of petrochemical characteristics the cocites of North Vietnam belong to group of high-magnesian, low-alumina, high-potassium melanomafites which have rather low-titanium content. These features, the same as enrichment of cocites in Cs, Rb, Ba, Th, La, Sr, and Zr with depletion in Nb, Ta, and Y allow them to be compared with low-titanium variety of lamproites.



## 5. Conclusions

Complete data of geological setting and substance composition of cocites suggest their similarity with lamproites of Mediterranean type (Mursia-Almeria in Spain and Aldan province in Russia) which occurred in the structures of late activity of folded regions and margins of platforms.

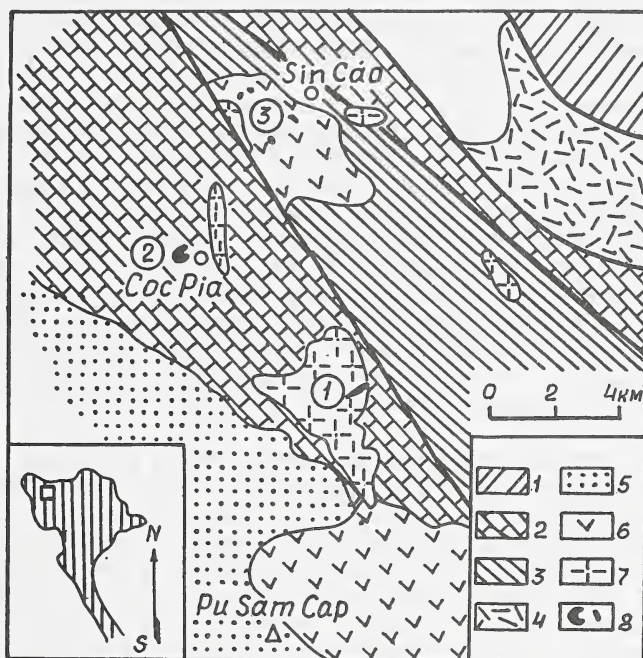


Fig. 1. Scheme of localization of the areas of cocite occurrence in geologic structures of North-Western Vietnam.

1 - Precambrian complexes of platform blocks, 2-5 - Mesozoic deposits: 2 - Dong Sao suite, T<sub>2</sub> (limestones with lenses of schists and aleurolites), 3 - Upper Triassic deposits, T<sub>3</sub> (clay shales, aleurolites, sandstones, gravelites), 4 - Jurassic-Cretaceous volcanic series Tule, J - K (rhyolites, rhyolite-porphyrries, quartz porphyries), 5 - Ien Chau suite, K<sub>2</sub> (conglomerates, sandstones, aleurolites, argillites), 6-7 - Paleogene complex Pu Sam Cap, P: 6 - alkaline syenites and syenite-porphyrries, 7 - volcanic series (trachytes, trachyte porphyries, absarokites), 8 - outcrops of cocites (1 - Nam Hon area, 2 - Coc Pia area, 3 - Sin Cao area).