# ON THE PYRRHOTITE CRYSTALS FROM DALNEGORSK

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Once upon a time I dreamt of a pyrrhotite specimen. I only had a poor fragment of uncertain origins; but I appreciated it because nothing else could be obtained. The mineral specimens were nowhere traded, except for small ends of ornamental stones put forward in the Moscow Pet Market. Nevertheless, just in this place I have bought my first crystal of pyrrhotite. This was a lucky break. Let it be not as nice as those in the magazine pictures but it was a real pyrrhotite crystal! It happened in the early 1980ties.

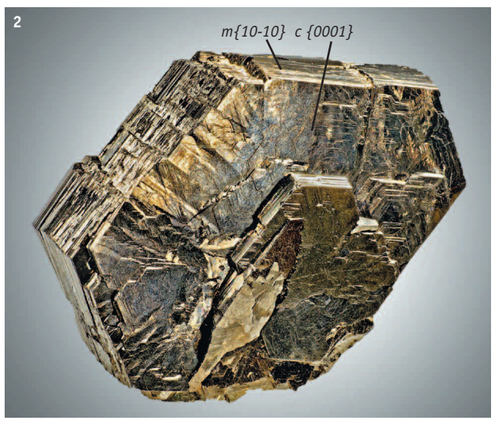
My collector's godsend became apparent to be a distant echo of a great event: in Dalnegorsk, Russian Far East, pyrrhotite crystals appeared and were mined in the Nikolaevsky Mine. Fine crystals they were. Of the worldclass quality if not the best in the world. In the Moscow "*Astonishing in Rocks*" exhibition, Volodya Pelepenko occupied then entire hall with his Dalnegorsk pyrrhotite specimens. There were a lot of them there. And every one was of the "killer" level. He named this exhibition "*My favorite mineral.*"

Yes, pyrrhotite is a collectors' fondling in very deed. This only refers to its crystals, though; pyrrhotite is mainly observed as plain granular masses. But what is this – pyrrhotite? What is there in it that makes it so attractive? Having learned more about pyrrhotite, one will find its crystals to be interesting not only for their outer glamour.

Pyrrhotite is an extraordinary mineral species. It is unusual yet in its chemical composition. It is ferrous sulphide; but the point is that it always contains iron in a slightly lesser and

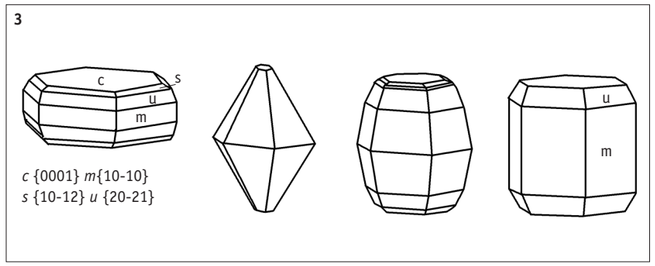
1. **Pyrrhotite**, tabular crystal 2 cm wide. Nikolaevsky Mine, Dalnegorsk, Russia. Specimen: A. Glotov.

2. **Pyrrhotite** crystal, 5.5 cm wide. Nikolaevsky Mine, Dalnegorsk, Russia.






3. **Pyrrhotite** crystals.




sulphur in a slightly larger proportion than one determined by the ferrous sulphide chemical formula FeS. In accordance with the crystallochemical studies, the pyrrhotite formula is $Fe_{1-x}S$ where x is the amount of the iron deficiency while $0 < x \leq 0.17$. This means that up to 17 percent of the Fe positions are vacant in the pyrrhotite crystal structure i.e. they do not contain iron. Such defects of the crystal structure are referred to as "*lattice vacancies.*" Not less interesting are the composition further details. If $x = 0$ i.e. there is no iron deficiency at all, then this is not yet pyrrhotite but rare hexagonal species FeS referred to as troilite. If however the iron deficiency takes place i.e. $x > 0$, then it's pyrrhotite. But here is also not that easy. If the iron deficiency does not exceed 0.113 ($x \leq 0.113$), pyrrhotite still retains the hexagonal structure (Minerals, 1960); but at $x > 0.113$ it is the monoclinic structure that becomes stable. Thus, the pyrrhotite mineral species exists in two modifications, hexagonal and monoclinic ones. For short, the hexagonal variety is referred to as hexapyrrhotite while the monoclinic one as clinopyrrhotite.

*Table 1.* ***Mineral species of pyrrhotite family***

| Iron deficiency | Mineral | Crystal system | Magnetizability |
|---|---|---|---|
| $x = 0$ | troilite | hexagonal | paramagnetic |
| $0 < x \leq 0.113$ | hexapyrrhotite | | |
| $0.113 < x \leq 0.17$ | clinopyrrhotite | monoclinic | ferromagnetic |

4. **Pyrrhotite** spindly crystal, 4.5 cm long. Nikolaevsky Mine, Dalnegorsk, Russia. Specimen: D. Edwards.

There are also "subvarieties" of these both pyrrhotite varieties. They are very similar, all of them, differing mainly in their chemical composition – Fe:S ratio as well as magnetic properties: hexapyrrhotite is paramagnetic while clinopyrrhotite is ferromagnetic. This difference does not prevent both from cohabiting in the same crystals. And these crystals are wonderfully nice, indeed: the outstanding goldy color with bronze "sunburn"; beautiful metallic luster somewhere masked with the brownish black tarnish; sharp hexagonal shape with the $L_6 6 L_2 7PC$[1] symmetry (*Fig.* 3); a wide variety of the crystal habits from the thin and thick tables (*Figs.* 1, 2) to the barrel like and quaint spindly shaped, elongated by the *c* axis (*Fig.* 4). And bonus: strong magnetism, a rare property in the mineral kingdom, priceless in the collector's praxis: it enables easy pyrrhotite identification (when there is no its frequent attendant magnetite, though). Another feature deserves attention too. The pyrrhotite crystals of various habits may be found within the same pocket: both tabular and columnar ones, direct and bended –

[1] Extensive formula of symmetry by A. Bravais; in the accepted now international Hermann-Mauguin system this corresponds to the symmetry class 6/mmm. – *Editor's* note.