

# MinIdent-Win - pentlandite

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**Formula:** (Ni,Fe)<sub>9</sub>S<sub>8</sub>

**Status:** Mineral name is IMA approved or traditional

**Level:** Species

**Parents:** cobaltpentlandite-pentlandite-series

**Symmetry:** Cubic

**Mean Atomic Number:** 23.5

**Diffraction Values:** 1.770, 3.030, 1.930, 5.790, 2.900

**Kretz abbreviation:** Pn

**First Described** in 1856

**Space Group:** Fm-3m

**Z number:** 4

**ICDD (TM) Number:** 30-657

|        | Minimum | Maximum | Average | Std. Dev. |
|--------|---------|---------|---------|-----------|
| a (Å)  | 9.930   | 10.190  | 10.060  |           |
| b (Å)  | 9.930   | 10.190  | 10.060  |           |
| c (Å)  | 9.930   | 10.190  | 10.060  |           |
| Alpha  | 90.000  | 90.000  | 90.000  |           |
| Beta   | 90.000  | 90.000  | 90.000  |           |
| Gamma  | 90.000  | 90.000  | 90.000  |           |
| Volume | 979.147 | 058.090 | 018.111 |           |

**Colour**  Opaque

| Reflectivity | Minimum | Maximum | Average | Std. Dev. |
|--------------|---------|---------|---------|-----------|
| 470 nm       | 39.60   | 43.90   | 41.75   |           |
| 546 nm       | 46.50   | 50.00   | 46.65   |           |
| 589 nm       | 48.55   | 51.95   | 48.77   |           |
| 650 nm       | 50.30   | 54.20   | 51.25   |           |

|         | Minimum | Maximum | Average | Std. Dev. |
|---------|---------|---------|---------|-----------|
| Mohs    | 3.5     | 4.0     | 4.0     |           |
| Vickers | 195     | 303     | 249     |           |
| Density | 4.60    | 5.00    | 4.80    |           |

|              | Total Min Wt (%) | Anal. Min Wt (%) | Average Wt (%) | Anal. Max Wt (%) | Total Max Wt (%) | Average Atomic | Coordination |
|--------------|------------------|------------------|----------------|------------------|------------------|----------------|--------------|
| S            | 30.5000          | 30.5000          | 33.3425        | 37.0000          | 37.0000          | 8.0000         | 4 5          |
| Cr           | 0.0000           | 0.0000           | 0.0060         | 0.0600           | 0.0600           | 0.0009         | 4            |
| Fe           | 0.0000           | 17.1650          | 30.1752        | 38.2400          | 38.2400          | 4.1561         | 4            |
| Co           | 0.0000           | 0.0000           | 1.0962         | 9.1300           | 9.1300           | 0.1431         | 4            |
| Ni           | 22.3100          | 22.3100          | 33.5111        | 41.9552          | 67.3220          | 4.3907         | 4            |
| Cu           | 0.0000           | 0.0000           | 0.5106         | 8.2944           | 8.2944           | 0.0618         | 4            |
| Zn           | 0.0000           | 0.0000           | 0.0010         | 0.0100           | 0.0100           | 0.0001         | 4            |
| As           | 0.0000           | 0.0000           | 0.0000         | 0.0000           | 0.0000           | 0.0000         | 4            |
| Se           | 0.0000           | 0.0000           | 0.0000         | 0.0000           | 0.0000           | 0.0000         |              |
| Ru           | 0.0000           | 0.0000           | 0.0218         | 0.2830           | 0.2830           | 0.0017         | 4            |
| Rh           | 0.0000           | 0.0000           | 0.8697         | 13.2000          | 13.2000          | 0.0650         | 4            |
| Pd           | 0.0000           | 0.0000           | 0.0094         | 0.0900           | 0.0900           | 0.0007         | 4            |
| Ag           | 0.0000           | 0.0000           | 0.0100         | 0.1900           | 0.1900           | 0.0007         | 4            |
| Sn           | 0.0000           | 0.0000           | 0.0000         | 0.0000           | 0.0000           | 0.0000         |              |
| Sb           | 0.0000           | 0.0000           | 0.0000         | 0.0000           | 0.0000           | 0.0000         |              |
| Te           | 0.0000           | 0.0000           | 0.0000         | 0.0000           | 0.0000           | 0.0000         |              |
| Os           | 0.0000           | 0.0000           | 0.0176         | 0.1229           | 0.1229           | 0.0007         | 4            |
| Ir           | 0.0000           | 0.0000           | 0.0062         | 0.1242           | 0.1242           | 0.0002         | 4            |
| Pt           | 0.0000           | 0.0000           | 0.1000         | 1.9000           | 1.9000           | 0.0039         | 4            |
| Pb           | 0.0000           | 0.0000           | 0.0208         | 0.2100           | 0.2100           | 0.0008         | 4            |
| Bi           | 0.0000           | 0.0000           | 0.0000         | 0.0000           | 0.0000           | 0.0000         | 4            |
| <b>Total</b> |                  |                  | 99.6981        |                  |                  | 16.8264        |              |

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Atomic proportions calculated for S = 8.0

Compilation based on 4 general and 32 sample records

*Values in italics are calculated from the minimum and maximum values. Other data are from the sample and general records.*

**Remarks:** Pale bronze-yellow with metallic lustre and a light bronze streak. It is brittle with a conchoidal to uneven fracture and no cleavage. The non-magnetic character distinguishes it from pyrrhotite with which it is commonly intimately intergrown. Sometimes it forms rims around pyrite to which it is more similar in appearance. Although often described in texts as "massive", truly massive occurrences are rare. Pentlandite is one of the principal sources of nickel. Although Ni usually dominates slightly over Fe in the metal site, some instances occur where Fe is dominant. Rhodian varieties also occur.

**Occurrences:** In hydrothermal ore deposits in basic and ultrabasic rocks. It is often associated with pyrrhotite. It is a major ore of nickel at Sudbury, Ontario, Canada.

**Localities of samples used in compilation:** Strathcona, Evans Creighton, Vermillion, Worthington, Frood, Copper Cliff & Stobie mines, Sudbury; Garson, Ontario; Thierry mine, northwestern Ontario, Canada. Wheal Jane, Truro, Cornwall, England. Northern Mountains, Oman. Joubdo stream, Birbir River, Ethiopia. Baula complex, Orissa, India. Driekop mine, eastern Bushveld Complex, Transvaal, South Africa. Horoman, Hokkaido, Japan.

**References:** Can. Min. v.7, p.30-145; v.17, p.275-285; v.22, p.13-21; v.25, p.245-249; v.40, p.277-309; v.41, p.597-616. J. Mineral. Petrol. Econ. Geol. v.93, p.369-379. NJMA v.183 (2), p.173-195. QDF for Ore Mins. B.M. (Nat. Hist.) 1986. Roberts et al. (1990) Encycl. Mins. Uytendogaardt & Burke (1971). Anthony et al. (1990).

# MinIdent-Win

Massive pyrrhotite containing pyrite inclusions with pentlandite rims.



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**Caption:** Pyrite ( $\text{FeS}_2$ ) crystals are surrounded by rims of pentlandite ( $(\text{Fe},\text{Ni})_9\text{S}_8$ ) and set in a matrix of massive pyrrhotite ( $\text{Fe}_{1-x}\text{S}$ ). The texture suggests that the pyrite has been partially pseudomorphed by pentlandite. Note the useful differences in colour of these three iron sulphide minerals: pyrite - brass yellow, pentlandite - bronze yellow and pyrrhotite - bronze brown. The streak colours, greenish black, bronze brown and black, respectively, are also useful in the differentiation of the minerals. Locality: Kambalda, W.A., Australia.

**Keywords:** pyrite; pentlandite; pyrrhotite; streak; colour; Kambalda; Western Australia; Australia; metallic lustre; brassy; bronze yellow; bronze brown; inclusions; reaction rims; sulphides; nickel ore; ferrimagnetism

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