VEIN GRAPHITE IN METAMORPHIC TERRAINS P05

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MINERAL DEPOSIT B.C. PROFILES

IDENTIFICATION

SYNONYMS: Lump and chip graphite, epigenetic graphite.

COMMODITY: Crystalline lump and chip graphite.

EXAMPLES (British Columbia (MINFILE #) - *Canada/International*): *Calumet, Clot, Walker and Miller mines and St. Sauveur occurrences (Quebec, Canada), Dillon (Montana, USA), Bogala Mine (Sri Lanka), deposits of South Kerala (India).*

GEOLOGICAL CHARACTERISTICS

CAPSULE DESCRIPTION: Graphite veins currently mined are from few centimetres to a metre thick. Typically they cut amphibolite to granulite grade metamorphic rocks and/or associated intrusive rocks.

TECTONIC SETTING(S): Katazone (relatively deep, high-grade metamorphic environments associated with igneous activity; conditions that are common in the shield areas).

DEPOSITIONAL ENVIRONMENT / GEOLOGICAL SETTING: Veins form in high-grade, dynamothermal metamorphic environment where metasedimentary belts are invaded by igneous rocks.

AGE OF MINERALIZATION: Any age; most commonly Precambrian.

HOST/ASSOCIATED ROCK TYPES: Hosted by paragneisses, quartzites, clinopyroxenites, wollastonite-rich rocks, pegmatites. Other associated rocks are charnockites, granitic and intermediate intrusive rocks, quartz-mica schists, granulites, aplites, marbles, amphibolites, magnetite-graphite iron formations and anorthosites.

DEPOSIT FORM: Veins are from a few millimetres to over a metre thick in places, although usually less than 0.3 meter thick. Individual veins display a variety of forms, including saddle-, pod- or lens-shaped, tabular or irregular bodies; frequently forming anastomosing or stockwork patterns. The mines in Sri Lanka are from 30 metres to 400 metres deep; individual veins rarely extend more than tens of metres.TEXTURE/STRUCTURE: Rosettes, coarse flakes, "fibers" or "needles" oblique or perpendicular to wall rock, or in some cases schistosity subparallel to the vein walls.

ORE MINERALOGY [Principal and *subordinate*]: Crystalline and microcrystalline graphite.

GANGUE MINERALOGY [Principal and *subordinate*]: Depends largely on the host-rock.
In marble or skarn: calcite ± *wollastonite ±hedenbergite ± zoisite ± clinozoisite ± prehnite ± quartz ± titanite ± sulphides ± diopside ± scapolite ± prehnite.*
In most of other rocks: feldspar ± *apatite ± garnet ± scapolite ± biotite ± sillimanite ± secondary iron oxides.*

ALTERATION MINERALOGY: Most veins are not surrounded by macroscopically distinguishable alteration halos, while some veins have narrow (< 1cm thick) alteration halos that are not well documented. Sillimanite, graphite-sillimanite or graphite-tourmaline alteration is reported adjacent to the veins in Sri Lanka and New Hampshire. In Quebec, some of the veins cut rocks with contact metamorphic or skarn characteristics. Sillimanite, graphite-sillimanite or graphite-tourmaline alteration is reported adjacent to the veins in Sri Lanka and New Hampshire.

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WEATHERING: In the near surface environments, graphite grades are enhanced by weathering out of gangue minerals.

ORE CONTROLS: Veins form along joints, breccia zones, crests of folds, decollements along geological contacts and foliations. Joints in brittle lithologies (such as hornfels or skarns in contact metamorphic aureoles associated with deep seated intrusive rocks) are particularly favourable. Relatively reducing conditions (within the graphite stability field).

GENETIC MODELS: The origin of graphite veins is controversial. The ultimate source of carbon may be vary from one deposit to other. Although most of the veins are hosted by high grade metamorphic rocks, the graphite precipitation may take place during the retrograde phase of the regional or contact metamorphism. This is suggested by coexistence of low temperature minerals such as prehnite with vein-graphite. Depending on the occurrence, the interaction of fluid with the host rock (internal or external buffering), such as oxidation of CH_4-bearing fluids by wall rock, cooling of a hot fluid nearly saturated with respect to graphite, or fluid mixing are the most probable causes of vein formation.

ASSOCIATED DEPOSIT TYPES: Commonly associated with disseminated crystalline flake graphite deposits (P04) and in some cases with wollastonite deposits (K09) and abyssal (ceramic) pegmatites (O04).

COMMENTS: 1) Crystalline graphite veins hosted by ultramafic rocks are relatively uncommon and are not covered by this profile.

2) Portions of the AA crystalline flake graphite deposit, located near the southern tip of Bentick Arm, British Columbia, contain microscopic graphite veinlets, suggesting that graphite veins may also occur in the metasedimentary roof pendants of the Coast Plutonic Complex.

EXPLORATION GUIDES

GEOCHEMICAL SIGNATURE: Veins may have in some cases narrow (< 1cm thick) alteration halos that are not well documented and are to thin to be of use in exploration. The chemical composition of ore is influenced mainly by the composition of gangue minerals.

GEOPHYSICAL SIGNATURE: Ground electromagnetic methods (VLF in initial exploration stage, horizontal or vertical loupe at later stages) and resistivity are the most appropriate methods to locate large graphite veins. "Mise a la masse" is useful in vein delineation.

OTHER EXPLORATION GUIDES: Graphite veins are most common in highly metamorphosed terrains and in several cases are associated with crystalline flake graphite deposits. Because graphite is inert in the weathering environment, boulder tracing and use of electomagnetic mats may be effective.

ECONOMIC FACTORS

TYPICAL GRADE AND TONNAGE: Veins contain 40 to 90% graphitic carbon before hand sorting. No reliable data is available on the tonnages for individual veins.

ECONOMIC LIMITATIONS: Since the deposits are relatively narrow veins, the mines are typically small scale, labour intensive and underground. The ore is hand sorted, washed and screened. Where possible, consumers substitute the less expensive and readily available crystalline flake graphite for vein graphite. The main technical parameter of the vein-graphite concentrate is its ability to mould to any shape and flow when exposed to extreme pressures.

END USES: Graphite from veins is used mainly in: powder metals, special refractories, copper graphite and carbon graphite brushes for electrical applications.

IMPORTANCE: The only current source of crystalline lump graphite is Sri Lanka; it is exported world-wide. British Columbia has no documented vein graphite occurrences.

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