

Figure 1: Regional Geology of the Merry Widow district (after Jeffery, 1962).

DESCRIPTION OF GEOLOGY AND MINERALIZATION

INTRODUCTION
The Merry Widow camp, situated about 40 kilometres southwest of Port McNeill on northern Vancouver Island, lies within the Wrangellia Terrane of the tectonic physiographic belt. It contains numerous Fe-Cu-Au skarn and magnetite occurrences, as well as some major skarn deposits.

GEOLOGY
The regional geology and stratigraphy of the area are shown in Figures 1 and 4 respectively. The oldest rocks in the map area are massive to foliated volcanic and subvolcanic gabbroic intrusions of the upper Triassic Karmutsen Formation. Adjacent to the larger intrusions the limestones are altered to white marble.

The Quesnois is unconformably overlain by the lower Jurassic Bonanza Group, argillites of the Paterson Bay Formation, which elsewhere in the district separate the Quesnois and Bonanza successions (Figure 1), appear to be absent in the Merry Widow area. The Bonanza includes andesitic ash and lapilli tuff (Units 1 and 2), breccia (Unit 3), greenstone (Unit 4) and well-bedded tuffaceous siltstone. One unit, close to the base of the Bonanza, contains irregular-shaped clasts that could be deformed pebbles or tuff fragments.

The area includes two major episodes of intrusive rocks. The oldest, the Keystone suite, is believed to be coeval with the Bonanza Group and probably formed leaders to the tuffs, breccias and greenstones in that succession (Figure 4). It resulted in swarms of minor sills and dykes, as well as some subvolcanic breccia pipes. The largest pipe, the Keystone intrusion, reaches 600 metres in diameter. The suite comprises fine to medium grained rocks of largely andesitic composition (Figure 5) and subvolcanic (Figure 6) and trace gold in a garnet-epidote-amphibole-carbonate gangue. The garnets vary from brown to yellow-green, and minor albite and potassium feldspar are locally present. Assays of sulphide-bearing grab samples indicate anomalous silver, arsenic and gold (Table 3).

Many Keystone suite dykes and sills that cut the Quesnois limestone are associated with barren and mineralized skarn, and the margins of some intrusions are bleached. These bleached rocks, compared to the unaltered andesite, are enriched in sodium and depleted in iron and potassium (Table 3).

The second major intrusive episode resulted in the emplacement of the Coast Copper stock. This is mostly a coarse grained, mafic gabbro of subalkalic and tholeiitic affinity (Figures 5, 6 and 7). It contains unaltered pyroxene, hornblende, plagioclase, ilmenite, magnetite and apatite. Locally it includes coarse pegmatite and feldspathic phases.

A distinctive sill-like body of unknown age intrudes the Quesnois limestone in the southern part of the map area. This tholeiitic basalt (Figures 5, 6 and 7) contains abundant pyroxene, is characterized by some cumulative layering, and is relatively enriched in magnesium and chromium (Tables 2 and 3).

STRUCTURE
Most bedding in the Quesnois and Bonanza successions dips westwards at between 20 and 50 degrees. Some open flexure folds are locally developed but tighter folding occurs near the margin of the Coast Copper stock in the Merry Widow pit area. At the pit, a north-northeast plunging, westerly overturned fold and east dipping thrust are identified by Lund (1966) (Figure 3). The fold strikes parallel to the margin of the Coast Copper stock.

MINERALIZATION
Mineralization in the area comprises skarns and mantos (Table 1). It is largely stratigraphically controlled, being mainly concentrated close to the bottom and top of the Quesnois limestone (Figure 4); similar stratigraphic relationships between the Quesnois and skarns are noted elsewhere in Wrangellia, such as on Teanuku Island (Webster and Ray, 1990).

Only the Merry Widow deposit outcrops close to the margin of the Coast Copper stock; the remainder of the deposits and occurrences outcrop some distance east of the intrusion. The mineralogy of the Merry Widow, Raven, Kingfisher and Old Sport-Benson Lake deposits is typical of other magnetite-rich skarns in western British Columbia (Sanger, 1989; Melner, 1984). The mineralization, based on a K-Ar analysis of skarn-related phlogopite, was dated by Carson (1973) at 181 Ma (mid-Jurassic).

The extensive Old Sport-Benson Lake skarn lies close to the Quesnois-Karmutsen contact, and the discontinuous ore lenses dip about 40 degrees westerly. Mineralization is characterized by magnetite, chalcopyrite, bornite, pyrite, lesser pyrrhotite and trace gold in a garnet-epidote-amphibole-carbonate gangue. The garnets vary from brown to yellow-green, and minor albite and potassium feldspar are locally present. Assays of sulphide-bearing grab samples indicate anomalous silver, arsenic and gold (Table 3).

The contact between the base of the Bonanza and the underlying Quesnois limestone is the locus of faulting, extensive skarn alteration, and mineralization responsible for the Merry Widow deposit and the Marten and Bluebird 1 and 2 occurrences. The Marten, Bluebird 1 and Bluebird 2 occurrences appear to represent sulphide-rich manto mineralization (Wilson, 1989). They include massive pyrrhotite, pyrite and chalcopyrite, with sporadic arsenopyrite, sphalerite, magnetite, marcasite and cobaltite. Grab samples from the Marten occurrence are enriched in arsenic, silver, bismuth and gold (Table 3).

The Merry Widow and Raven deposits (the latter is now covered by tailings) are hosted by Keystone andesite intrusions and Bonanza rocks close to their contact with Quesnois limestone and the Coast Copper stock; by contrast the Kingfisher is hosted entirely in limestone (Figure 3). The Kingfisher deposits consist of two steeply plunging, sub-circular pipes of massive magnetite. They reached 50 metres in diameter and were joined at depth (Figure 3). Skarn wallrock alteration is poorly developed compared to the nearby Merry Widow deposit. The Kingfisher deposits are distinct in being structurally controlled along the Kingfisher fault and in containing abundant coliform magnetite. Stevenson and Jeffery (1964) believed this mineral coliform texture indicated deposition of the magnetite as a gel by colloidal processes.

The Merry Widow is characterized by abundant coarse crystalline magnetite, some minor coliform magnetite, and sporadic pyrrhotite, pyrite, arsenopyrite, cobaltite, erythrite, sphalerite and gold in a gangue comprising garnet, epidote, actinolite, clinopyroxene, carbonate and quartz. Magnetite forms lenses, sheets and discontinuous breccia zones; the latter comprising magnetite-calcite fragments rimmed by coarse garnet. Garnets are generally brown coloured; they typically have isotropic cores and rimmed and/or grading outward to anisotropic periferic zones (Eitinger and Ray, 1989). Both the garnet and pyroxene have a low manganese content (Melner, 1984; Eitinger and Ray, 1989) that is typical for calcic iron and gold skarns. Locally, albite and potassium feldspar are associated. Gold tends to be found in the sulphide-rich zones, and Dixon (1989) reports it is associated with cobaltite and tellurobismuthite. Gold-rich ore occurs along the hanging wall of the West Pipe dyke (Lund, 1966; Figure 3), a ventifact-bearing Keystone suite intrusion. The Raven Copper occurrence, on the north side of the Merry Widow pit, is another example of gold-sulphide-rich mineralization in the Merry Widow deposit. A chalcopyrite-bearing grab sample contains anomalous gold, silver, zinc, cobalt, arsenic and bismuth (Table 3).

Two theories are suggested for the origin of the skarns and mantos. The most accepted hypothesis is that the mineralization is genetically related to the Coast Copper stock. This suggests (based on the K-Ar dating of the skarn) that the intrusion is mid-Jurassic in age. Alternatively, the Keystone intrusions, which are commonly altered to endokarns and associated with magnetite and sulphides, could be responsible for the skarns. Each hypothesis has different implications for future exploration.

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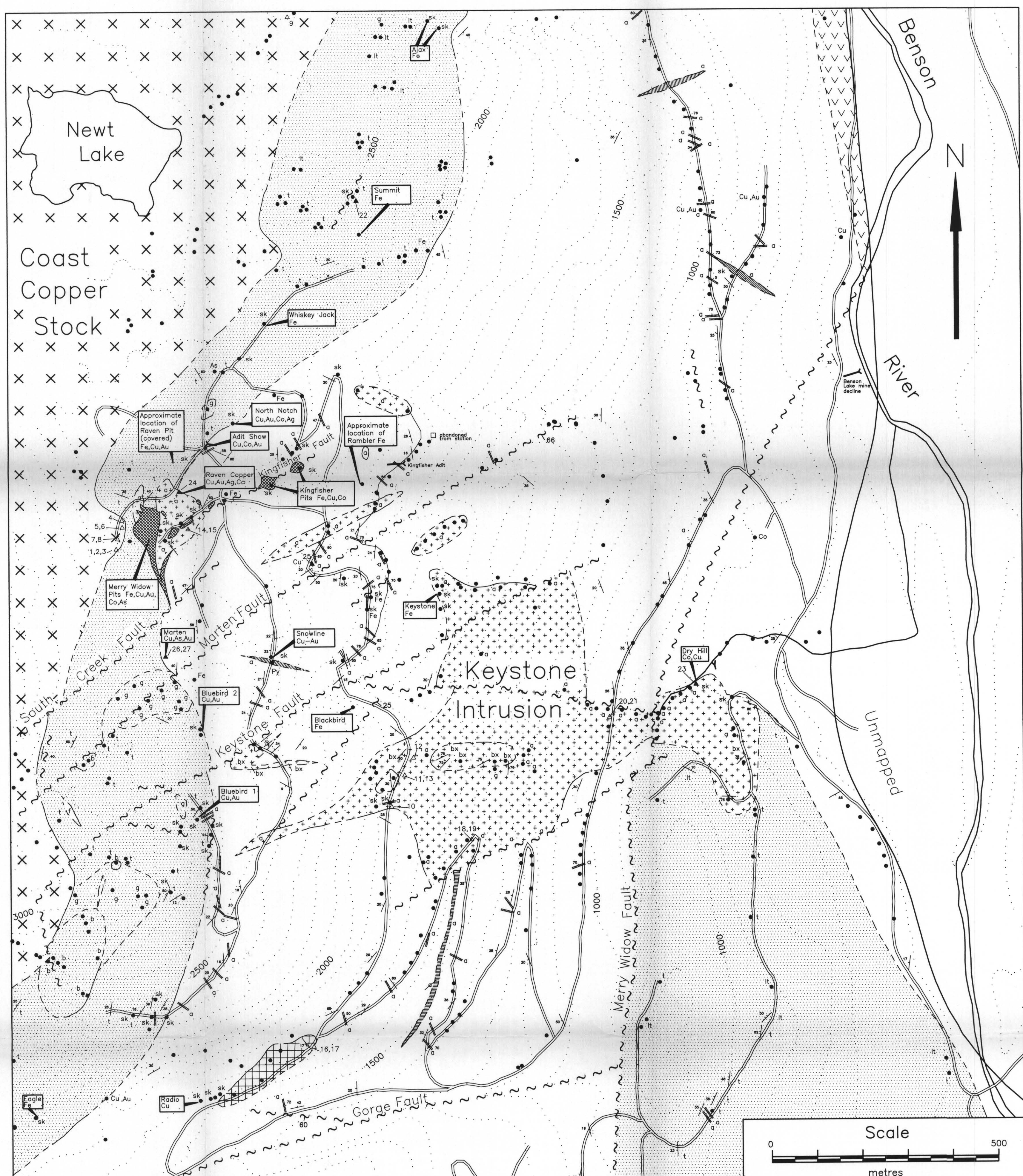


Figure 3: Longitudinal geological section across the Merry Widow-Kingfisher Pits (adapted after Lund, 1966).

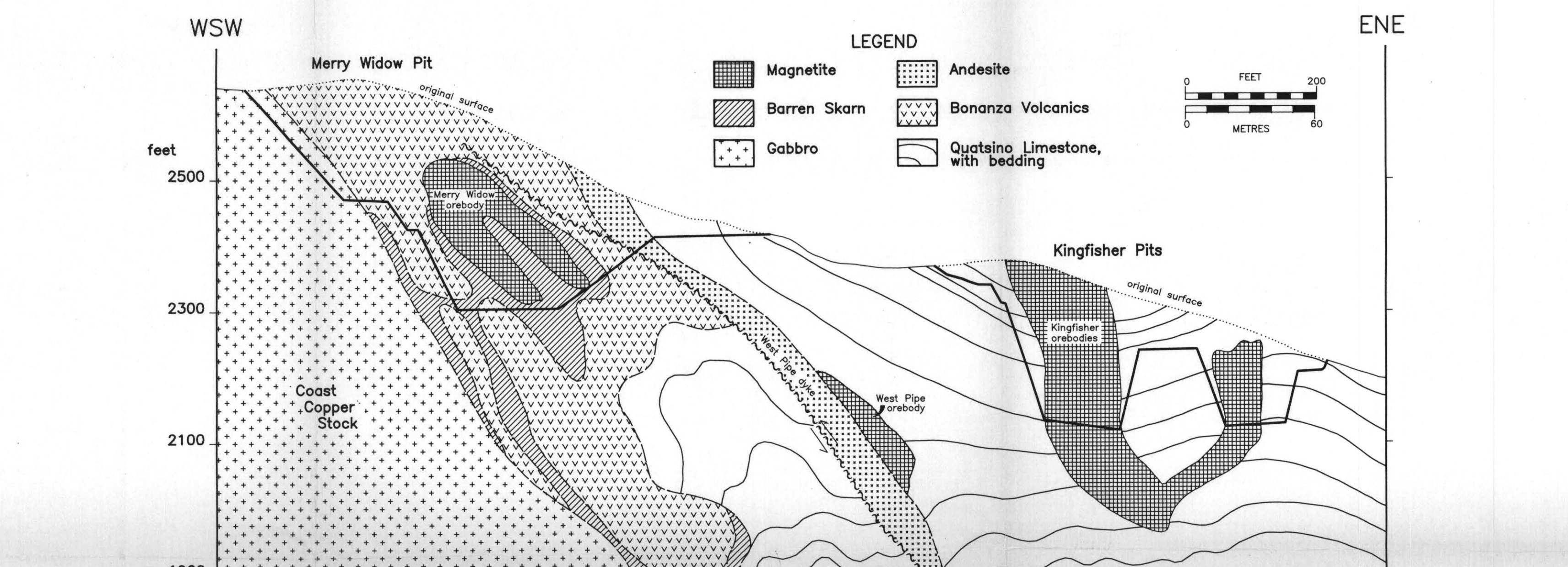


Figure 3: Longitudinal geological section across the Merry Widow-Kingfisher Pits (adapted after Lund, 1966).

Table 1. Mineral occurrences: description and production.

Table with columns: Mine Name, Deposit Type, Metallic Elements, Mineralogy, and Production. Includes entries for Old Sport, Shavrock, Ajaik, Summit, Merry Widow, Kingfisher, Raven, Whiskey Jack, Bluebird, and Marten.

Table 2. Whole rock geochemistry of intrusive rocks (oxides, LOI, and Sum in %, other elements in ppm).

Table with columns: No on Fig. 2, SiO2, TiO2, Al2O3, Fe2O3, MnO, MgO, CaO, Na2O, K2O, Qz, P2O5, Ba, Sr, Zr, Y, Nb, La, Sum. Includes a note about mineral abbreviations and a note about the concentration of some elements.

Table 3. Trace element analyses of mineralized samples, Merry Widow area (all values in ppm except where stated in %, ND=not detectable).

Table with columns: No on Fig. 2, Mo, Cu, Pb, Zn, Ag, Ni, Co, Au, Cd, Sb, Bi, Cr, W. Includes a note about analyses completed at Arne Analytical Laboratories Limited.

LEGEND

- AGE UNKNOWN: LAYERED BASALTIC SILL.
EARLY TO MIDDLE JURASSIC: MASSIVE MAGNETITE.
ISLAND PLUTONIC SUITE: COAST COPPER STOCK (GABBRO), MINOR GABBROIC INTRUSION RELATED TO COAST COPPER STOCK.
KEYSTONE SUITE: LARGE ANDESITIC BRECCIA PIPES, MAJOR SILLS AND DYKES, LOCALLY XENOLITHIC, MINOR ANDESITIC INTRUSIONS (SILLS AND DYKES).
LOWER JURASSIC: BONANZA GROUP: ASH TUFFS, TUFFACEOUS SEDIMENTS, LAPILLI TUFFS; BRECCIA (POSSIBLE LAPILLI TUFFS OR INTRUSIVE BRECCIA); GREENSTONE (POSSIBLE FLOWS OR SUBVOLCANIC INTRUSIONS).
UPPER TRIASSIC: VANCOUVER GROUP: QUATSIINO FORMATION (MASSIVE TO BEDDED LIMESTONE); KARMUTSEN FORMATION (BASALTIC FLOWS, SUBVOLCANIC INTRUSIONS).

- SYMBOLS: Bedding, tops known; Bedding, tops unknown; Intrusive flow lating; Cumulative layering; Geological contact, defined, assumed; Dyke or sill (with dip - where recorded); Fault (with dip - where recorded); Contour (100 foot interval); Road; Outcrop visited; Whole rock sample location; Trace element assay sample location; Adit; Skarn; Magnetite.

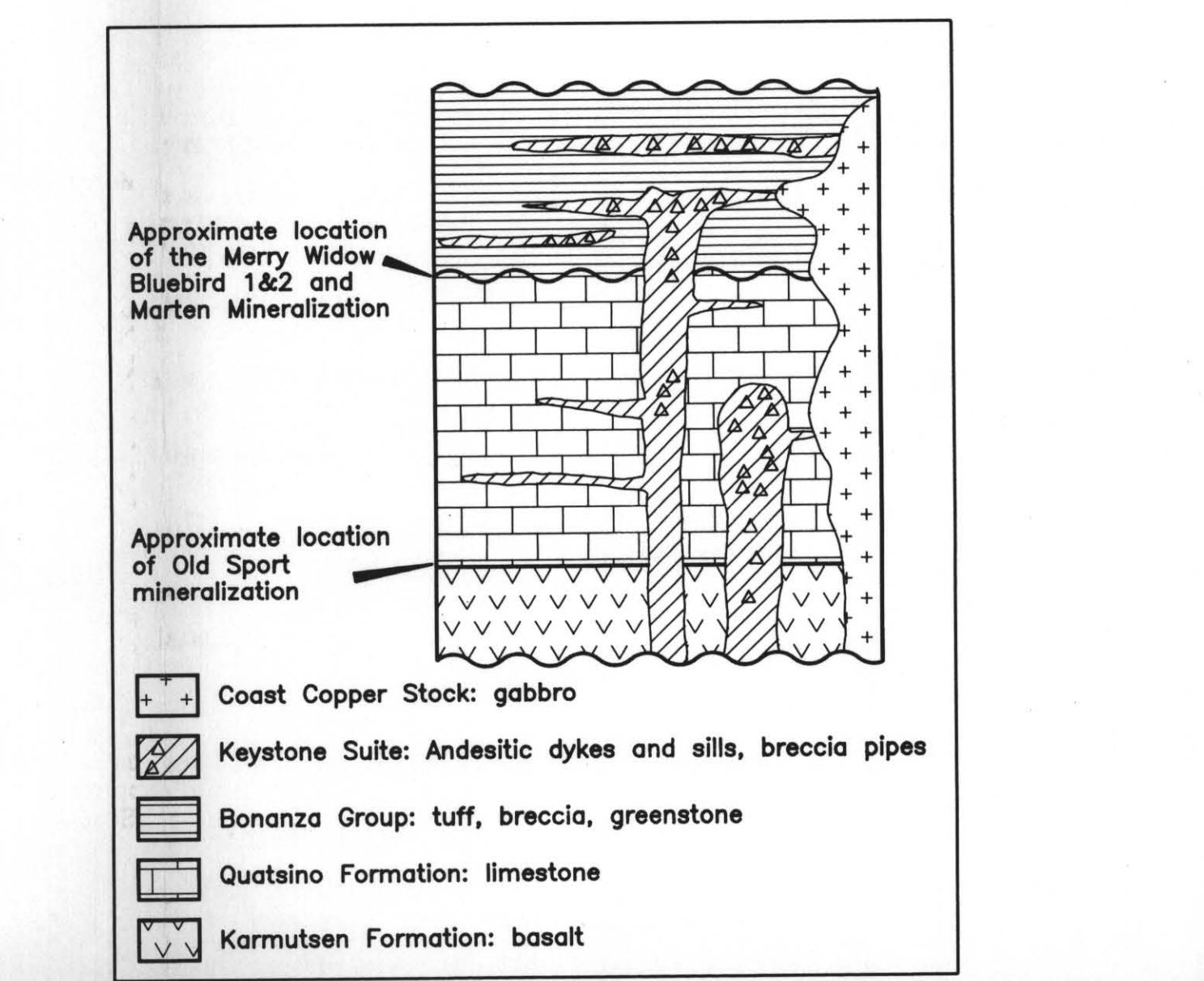


Figure 4: Schematic stratigraphic column, Merry Widow area.

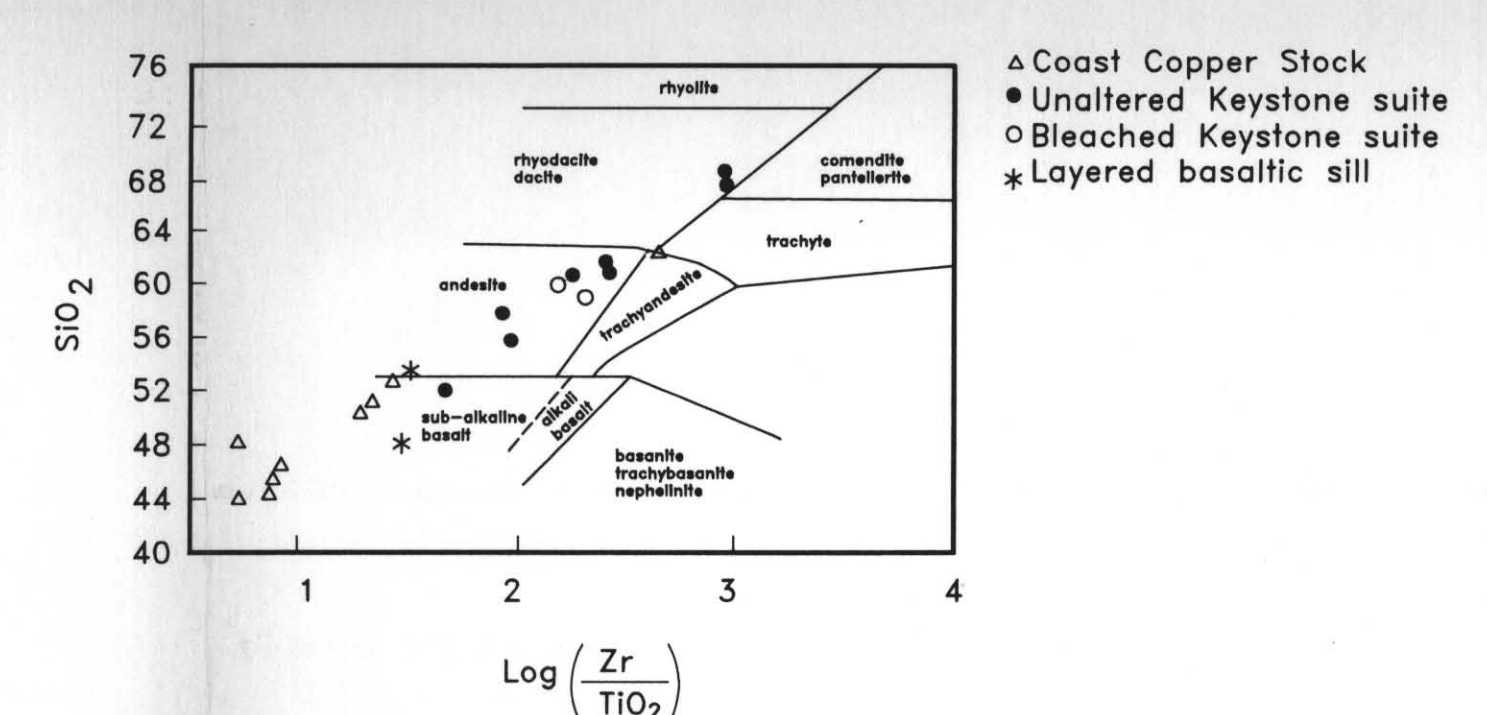


Figure 5: Plot of SiO2 vs. log (Zr/TiO2) (after Floyd and Winchester, 1978) of intrusive rock samples, Merry Widow area.

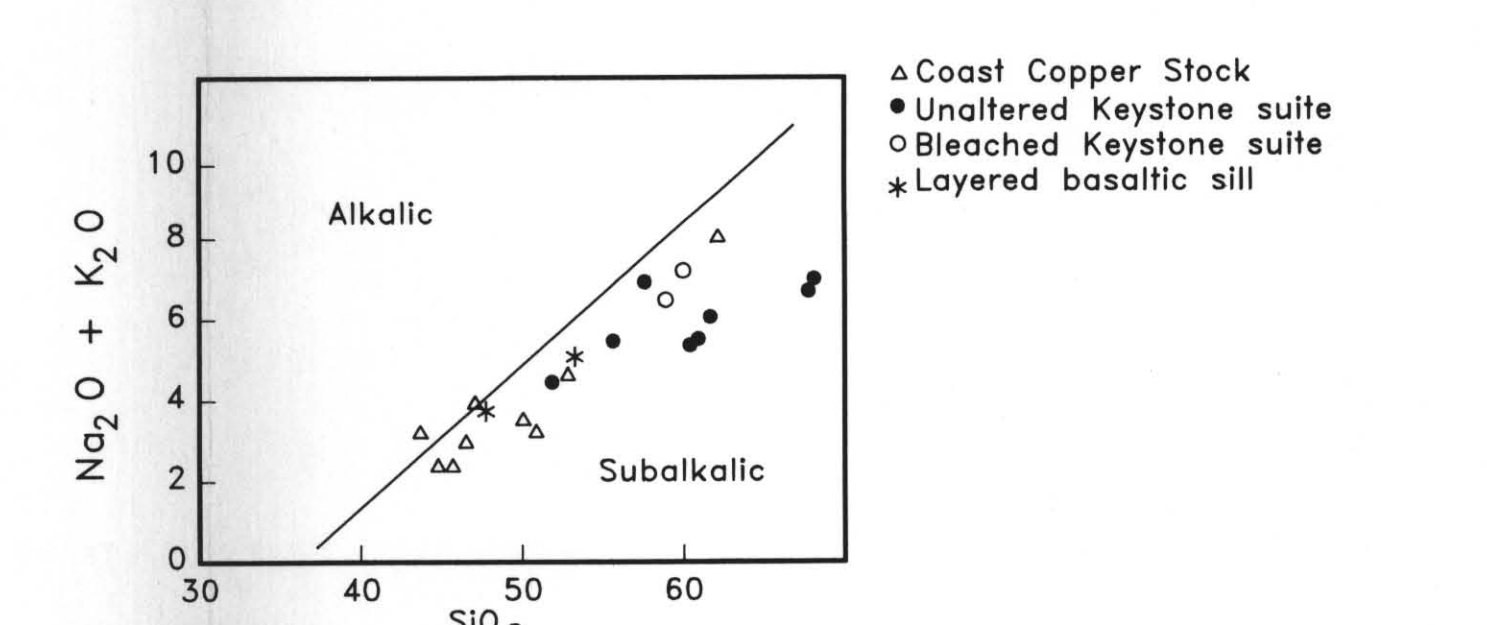


Figure 6: Alkali-silica plot (after MacDonald, 1968) of intrusive rock samples, Merry Widow area.

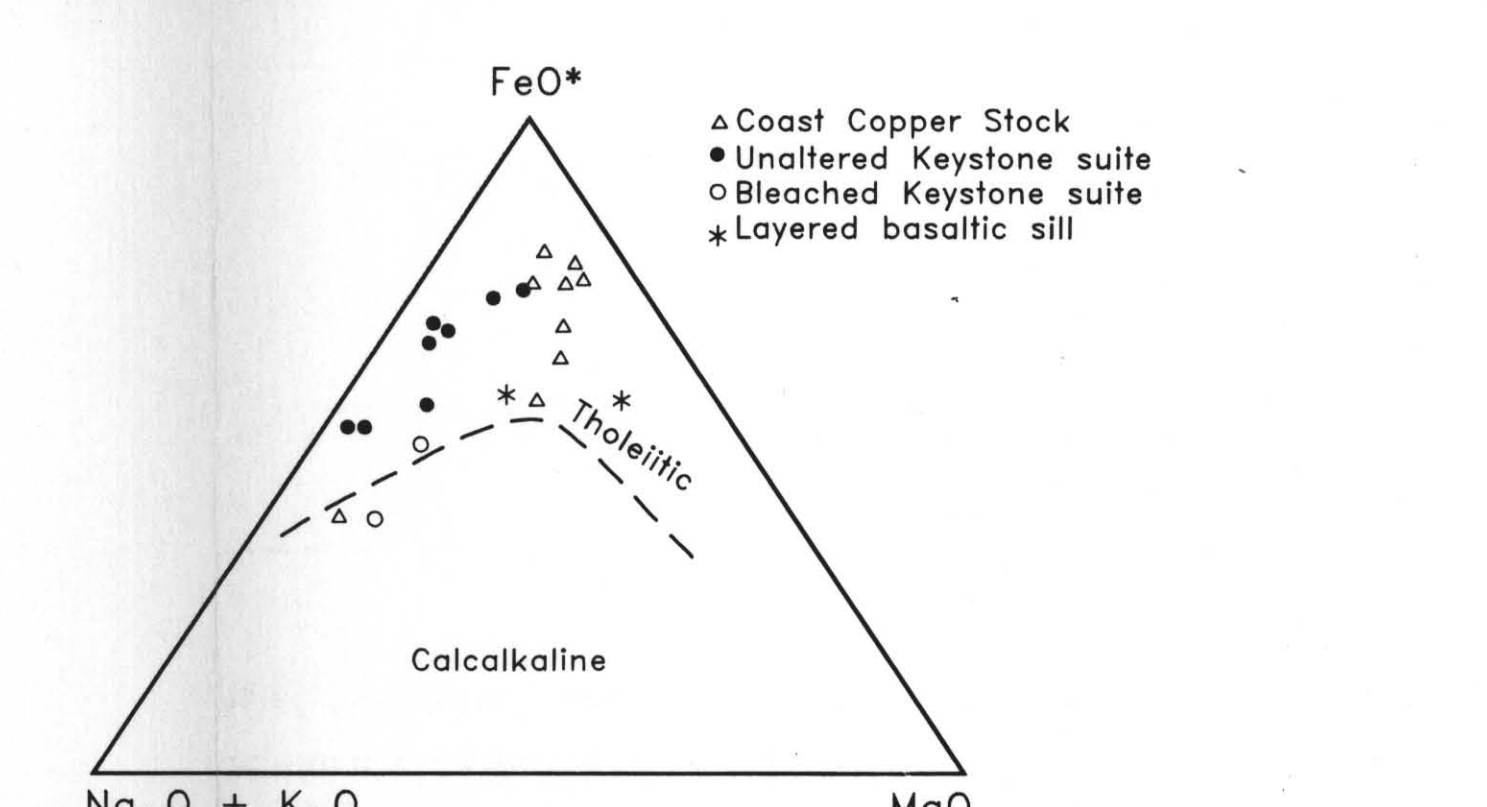


Figure 7: AFM plot of intrusive rock samples, Merry Widow area.