Sullivan 888146

the South Fork Volcanics. The older suite of plutons appears to be correlative with the Cassiar plutonic suite in the Cassiar Terrane southwest of the Tintina Fault Zone. Accessory minerals and geochemical compositions are distinctive for each of the redefined plutonic suites. Stable and radiogenic isotopic compositions indicate considerable influence of radiogenic, in part metasedimentary, crustal protoliths in the genesis of the plutons.

The metallogenic signature of each of the plutonic suites defined above is also distinctive. The Tombstone plutonic suite is metallogenically extremely diverse, and includes porphyry Au deposits (e.g.,, Fort Knox; Dublin Gulch), W(-Au, Cu) skarns (e.g.,, Ray Gulch, Mactung, Cantung), disseminated Au (e.g.,, Brewery Creek), and a wide range of Au- and base metal-bearing vein and vein breccia occurrences. Mineralization associated with the older of the two-mica, Selwyn suite plutons includes W skarns in the Finlayson Lake map area and Ag-Sn vein occurrences in the Tay River map area. No mineral occurrences are known to be associated with the younger Selwyn suite intrusions or related South Fork Volcanics. Recognition of the age and distribution of specific plutonic suites, and the commodities and deposit types associated with each suite can provide valuable criteria to guide both regional and detailed mineral exploration programs.

***10:10*** *John Lydon and Sullivan team*

**The Sullivan Deposit and its Geological Environment**

The Sullivan Project is a collaborative effort with Cominco Ltd. to document the geological and geochemical details of the Sullivan deposit for the public record, and to enhance understanding of its geological environment with specialist studies. Some current conclusions pertinent to mineral exploration models include:

Tectonic setting - Turbidites of the Aldridge formation, which hosts the Sullivan deposit, represent the fill sequence of a north trending Middle Proterozoic rift (*Höy*). Basinal analysis (*Chandler*) and petrochemistry of the tholeiitic Moyie Sills (*Anderson*) intercalated with the turbidites indicate that the rift was intracontinental and formed in response to crustal extension rather than in response to a thermal plume in the asthenosphere. Stratigraphic analysis (*Höy*) reveals synsedimentary tectonism was expressed as northerly trending border faults and easterly to northeasterly trending transfer faults.

Environment - Several lines of evidence indicate that Aldridge sediments accumulated in a marine environment:

- Sedimentological evidence of tidal action in laterally equivalent and overlying strata (*Chandler*).
- High sulphur contents and high S/C ratios of Aldridge sediments indicate high sulphate contents of sediment pore waters and therefore marine conditions (*Goodfellow*).

- Boron isotopes of tourmalinite bodies in Aldridge rocks indicate the boron was leached from marine sediments (*Palmer, Jiang*).

Widespread lagoonal or lacustrine conditions did not develop until higher in the Purcell stratigraphy during the Creston through Dutch Creek formations, which represent the rift sag (rift cover) sequence (*Chandler, Höy*). Sabkha evaporites in units correlative with the Aldridge formation indicate a hot and relatively dry climate (*Chandler*).

Siting of Sullivan deposit - The Sullivan deposit occurs at the intersection of the north trending axial(?) zone of the rift and a transfer fault (proto-Kimberley fault). The axial(?) zone was the locus of maximum heat flow and hydrothermal upflow as evidenced by:

- concentration of tourmalinite occurrences in Aldridge-Pritchard strata (*Slack*).
- concentration of Aldridge Zn-Pb occurrences (*Höy, Turner*).
- maximum cumulative thickness of Moyie sills (*Höy, Turner*).
- a synsedimentary tectonic lineament and zone of hydraulically disrupted sediments (*Turner, Höy*).
- Proterozoic felsic intrusions.

Timing of mineralization - U/Pb dating of zircons from Moyie sills from both lower and middle Aldridge formation is 1467 $\pm$ 3 Ma (*Anderson, Davis*). Ore sulphide mineralization at Sullivan predates the Mine Sill. Pb isotope compositions of Sullivan sulphides form a linear array indicating lead contributions from at least two sources: orogene and mantle. Other sedex-type occurrences in the Aldridge formation plot along the less radiogenic extension of the Sullivan array. Pyrite-calcite alteration of the ore sulphides display different Pb isotope compositions and is up to 100 Ma younger than emplacement of the ore sulphides (*Beaudoin*). The Sullivan Horizon coincides with an excursion to increased $\delta$34S values in diagenetic sulphides, indicating a period of water column stratification and reducing bottom conditions during the time of Sullivan ore deposition (*Goodfellow*). The stratigraphic position of Sullivan in the rift fill sequence is anomalous when compared to most other sedex deposits, which typically occur in the rift sag sequence. In this connection, the Mineral King deposit in the Dutch Creek Formation, for example, which may be of the sedex type, occupies a more typical stratigraphic position (*Lydon*).

Nature and source of hydrothermal fluids - Boron isotopes of tourmalinites, whose formation brackets ore sulphide deposition at Sullivan but occur independently of sulphides elsewhere within the Belt-Purcell Supergroup, suggests the boron at least was derived by the leaching of marine sediments or permissibly by the dissolution of continental evaporites, but precludes the hydrothermal fluids from being evaporated seawater or derived by the dissolution of marine evaporites (*Jiang, Palmer, Slack*). Secondary fluid inclusions in quartz veins cutting tourmalinite in the footwall of the Sullivan deposit, and spatially associated with Pb-Zn mineralization elsewhere in the Aldrich formation, that contain 15-27 wt. % NaCl + CaCl2($\pm$MgCl2), may represent the ore-forming fluids (*Leitch*). Oxygen and hydrogen isotope compositions of

hydrothermally altered sediments at Sullivan, are consistent with alteration by slightly modified seawater at 150-250°C (*Taylor*).

The Sullivan deposit - Metamorphic recrystallization and tectonically induced mechanical and chemical remobilization has blurred textural features and original extent of the sulphide body (*Del Bel Belluz, Lydon, Paakki*). Early manganiferous sediments and bedded sulphide clasts in mudflows (Waste Bands) indicate at least a component of seafloor metalliferous sedimentation (*Ransom, Lydon*). Metasomatic subsurface zone refinement during ore deposition obfuscates arguments for the subsurface replacement versus sedimentary debate on the origin for sedex deposits (*Lydon, Paakki*).

Sullivan Project participants whose work is cited:

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*10:50 Bert Struik, Peter van der Heyden, Peter Mustard, Paul Metcalfe, Rob Shives, Colin Dunn, Alain Plouffe, Dennis Teskey, Geological Survey of Canada*
**Highlights of the Interior Plateau Program, Canada-British Columbia Agreement on Mineral Development**

Latest results from the program's six subprojects are summarized. The regional aeromagnetic survey covered 59 adjoining 1:50 000 map areas in the Interior Plateau, and the data has been released. Preliminary interpretations define hidden geological contacts and faults. Airborne gamma ray spectrometry, total field magnetic, and VLF-EM surveys centred on the Fish Lake (92O) porphyry copper-gold and the Clisbako River (93B,C) epithermal precious metal camps were completed in 1994. Anomalous radioelement concentrations (K, U, Th) at both camps are attributed to mineralizing solutions that have altered the bedrock and have been reworked into the surficial sediments. Bedrock geologic mapping of the Charlotte Lake-Junker Lake (NTS 93C/3,4E) and Bussel Creek-Tatla Lake (NTS 92N/14E,15) map areas was completed in 1994. Cretaceous northeasterly directed thrust imbrication of Coast Belt and Intermontane Belt rocks, includes mid-Cretaceous nonmarine Silverquick Formation, and is intruded by the ca. 63-67 Ma Klinaklini and McClinchy plutons. Triassic volcanic and sedimentary rocks, between Yalakom and Tchaikazan faults, are intruded by the 205 Ma Sapeye Creek pluton and the 212 Ma Niut pluton. Early to Late Jurassic U-Pb ages have been obtained from metarhyolites (190 Ma) and plutons of diorite and granodiorite (168 Ma - 142 Ma). The Copper Queen Cu and C/DK Cu-Mo showing near McClinchy Lake may represent a fault-controlled, high structural level of a classic altered mineralized porphyry system hosted by the Wilderness Mountain pluton. Study of Eocene volcanic stratigraphy of the Clisbako