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04:00 PM McKinley, Sean D.

VOLCANIC STRATIGRAPHY AND LITHOGEOCHEMISTRY OF THE SENECA Zn-Cu-Pb VMS PROSPECT, SOUTHEASTERN BRITISH COLUMBIA.

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The Seneca property, 120 kilometers east of Vancouver, B.C., is a Zn-Cu-Pb volcanogenic massive sulfide prospect hosted by intermediate to felsic volcanic rocks of the Lower to Middle Jurassic Harrison Lake Formation. Geological reserves are estimated at 1.5 Mt grading 3.6% Zn, 0.6% Cu and 0.1% Pb. Three principal volcanic facies host the mineralization: 1) dacite and basaltic andesite lavas; 2) juvenile and reworked volcaniclastic rocks; and 3) rhyolitic to basaltic synvolcanic intrusions. Felsic flows and synvolcanic intrusions are similar texturally and compositionally, and contain up to 15% plagioclase and 5% quartz phenocrysts. The general lack of flow textures in the dacite and rhyolite porphyries and their massive internal textures suggests that synvolcanic intrusions are more prevalent than flows. Interpreted sills, which are up to several tens of metres thick, often have thin chilled and/or brecciated margins and bedding-parallel contacts, and locally exhibit peperitic textures where they interact with volcaniclastic rocks. The volcaniclastic sequence consists of an overall fining-upward package of rocks which varies from heterolithic to dacitic breccias and conglomerates, to finer grained volcaniclastic sandstones and siltstones that can exhibit normal grading and cross-bedding.

Three types of mineralized zones exist: 1) a conformable massive sulfide lens of 2 metres of sphalerite and chalcopyrite (33-Zone); 2) massive to disseminated conformable and matrix-filling sphalerite, pyrite, chalcopyrite and barite associated with an altered dacitic volcaniclastic unit (Pit Area); and 3) stockwork and stringer mineralization consisting of sphalerite-pyrite-chalcopyrite-quartz veins hosted almost entirely by strongly silicified and sericitized dacite porphyry (Fleetwood and Vent Zones). Major, trace and rare-earth-element data show the volcanic rocks have a calc-alkaline affinity consistent with formation in a island-arc setting. Incompatible-immobile element plots suggest two compositional groupings, from basalt to basaltic andesite, and from dacite to rhyolite. The basalts are spatially distinct from the basaltic andesites and may have formed from different eruptive centres. Vertical and perhaps lateral facies relationships within the volcaniclastic rocks suggest an overall change from a higher energy, mass flow regime to more quiescent depositional environment consistent with deepening water in a foundering basin.

04:15 PM Childe, Fiona

THE GRANDUC VMS DEPOSIT, NORTHWESTERN BRITISH COLUMBIA: U-Pb AGES AND Pb ISOTOPE RELATIONS

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The Granduc deposit is a cupriferous Besshi-type deposit that occurs within Stikinia, an allochthonous volcanic arc terrane in the Canadian Cordillera. The Granduc mine was in operation between 1971-1978 and 1980-1984, with a total production of 15.2 Mt of 1.3% Cu. Current reserves are 9.9 Mt grading 1.8% Cu. Although the host stratigraphy is strongly deformed and metamorphosed to upper greenshist facies, the broad stratigraphic relations can be discerned. The footwall of the deposit consists of flows and tuffs of basalt to basaltic andesite composition. Low contents of incompatible elements, Zr/Y ratios of ~3-4, and REE patterns with slight enrichment of LREE relative to MORB are consistent with an oceanic back-arc or early (tholeiitic) stage of island-arc formation. Mineralization occurs as semi-massive sulphides interbedded with argillite, chert, magnetite-silicate iron-formation, and possible dacitic tuffs. The hangingwall consists of distal turbidites and pelagic sediments. Previous attempts to date the deposit have been unsuccessful due to the mafic nature of the footwall, and the lack of fossiliferous strata.

Zircon recovered from a basaltic andesite flow gives a preliminary U-Pb age of 230.5±14 Ma. A coarse-grained, variably deformed quartz dioritic sill which intrudes the footwall in the North Zone of the deposit yields an age of 232±3 Ma, which further constrains the age of the footwall and overlying mineralization. The Granduc deposit is the first known occurrence of VMS mineralization within the Upper Triassic Stuhini Group of the Stikine Terrane. Lead isotopic analysis of pyrite and galena from the stratabound mineralization yield ratios of $^{206}Pb/^{204}Pb$ = 18.62-18.65, $^{207}Pb/^{204}Pb$ = 15.56-15.59, and $^{208}Pb/^{204}Pb$ = 38.19-38.27. These values are notably less radiogenic than mineralization of known Early Jurassic age in Stikinia, supporting a pre-Jurassic age of mineralization. Galena and microcline from Pb-Zn-Ag rich veins in the footwall have compositions of $^{206}Pb/^{204}Pb$ = 19.18-19.19, $^{207}Pb/^{204}Pb$ = 15.62-15.64, and $^{208}Pb/^{204}Pb$ = 38.66-38.70, which overlap with those for mineralization associated with the Tertiary Hyder Plutonic Suite. These veins are younger than, and unrelated to VMS mineralization. Zircon from recently recognized felsic stratigraphy located a few kilometres from the Granduc mine yields an age of 185.4 +9/-0.4 Ma. These Jurassic felsic rocks, now fault-bounded against the Granduc stratigraphy, may be partly equivalent to Hazelton Group felsic stratigraphy that hosts mineral deposits in the Iskut region 20-50 kilometres to the north.

04:30 PM Bleeker, Wouter

NEW U-PB ZIRCON AGES FOR KIDD CREEK: IMPLICATIONS FOR THE FORMATION OF GIANT VMS DEPOSITS AND THE TECTONIC HISTORY OF THE ABITIBI GREENSTONE BELT

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The giant Kidd Creek Cu-Zn-Ag deposit (140 Mtonnes), in the Southern Volcanic Zone of the Abitibi Greenstone Belt, is among the largest VMS deposits in the world. In conjunction with a detailed structural and stratigraphic synthesis of the deposit and its regional setting, new precise U-Pb zircon ages have been established for immediate footwall and hanging wall rhyolites, at 2714.1±1.5 and 2710.5±1.1 Ma respectively. Both rhyolites are intimately associated with mineralization. We consider the demonstrated longevity of the Kidd Creek hydrothermal system, without being interrupted by major extrusion of flows or deposition of voluminous sediments, as one of the major controls on its giant size. Consideration of age constraints together with the size of the deposit suggests a time-averaged rate of base-metal sulphide deposition in the range of 0.1 to 10 grams/second.

Detrital zircon ages on greywacke turbidites in the deeper footwall to the deposit support structural observations that the underlying and regionally extensive metasediments are unrelated and significantly younger than the volcanics that host the deposit. All greywackes south of Kidd Creek are younger than ~2699 Ma; some of the greywackes and possibly all are younger than 2683±6 Ma. The data contradict earlier views that the greywackes are broadly time-equivalent with the volcanic stratigraphy. Instead our data enhance the view that deposition of most major greywacke packages in the Southern Volcanic Zone of the Abitibi Greenstone Belt, as well as in neighbouring subprovinces, significantly post-dated volcanism and signifies the onset of thrusting, uplift, and accretion (*ie.* flysch).

04:45 PM Hitzman, Murray W.

ARGON-ARGON STEPHEATING STUDIES OF MUSCOVITE IN THE UPPER DEVONIAN OLD RED SANDSTONE: THE FIRST ABSOLUTE DATES FOR THE AGE OF IRISH ZINC-LEAD MINERALIZATION

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The Upper Devonian Old Red Sandstone fluvial-deltaic, red bed sequence is >6km thick in southern Ireland and thins northward until it pinches out in the north-central Irish Midlands. The sequence has been proposed as a regional aquifer for the hydrothermal fluids that formed the Irish Zn-Pb-Ag-Ba deposits. Detailed petrographic studies indicate that the sequence is highly altered beneath individual orebodies with hematite bleaching, alteration of detrital muscovite and feldspar to "sericite," and occlusion of porosity by ferroan dolomite and minor sulfides which can be isotopically related to alteration within the overlying orebodies. ^{40}Ar-^{39}Ar stepheating analysis of muscovite separates was conducted on samples from two deposits (Silvermines and Lisheen) and two unmineralized areas from south-central (Devilsbit) and central (Clane) Ireland. A sample of igneous muscovite from a tungsten greisen in the Devonian Leinster batholith was also analyzed as a control. The Leinster igneous muscovite shows a pronounced plateau at the supposed age of formation (~385 Ma) and has no subsequent argon loss. The Silvermines samples display plateaus at ~525 and 475 Ma indicating that the sandstones was derived from multiple lower Paleozoic source terranes. The samples also display major Ar loss at ~360 and ~380 Ma suggesting some detrital muscovite was derived from Devonian intrusions. One sample shows minor loss at ~337 Ma. The Lisheen samples have plateaus at ~450 and 480 suggesting an Ordovician provenance for the detrital muscovite. One sample shows major argon losses at ~350 and ~315 Ma while the other shows a major argon loss at ~340 Ma. The Devilsbit and Clane samples display plateaus at ~395 and ~385 Ma and minor losses at ~330 and ~325 Ma. The cluster of argon loss ages from ~350 to ~337 probably represent the period of hydrothermal alteration that resulted in the formation of the zinc-lead deposits. This lower Carboniferous age (Chadian - Arundian) is consistent with the geologic data from the deposits and indicates a mineralization age of 5-15 million years after host-rock deposition. Younger ages of argon loss date alteration of detrital muscovite and formation of secondary micas during the Hercynian orogeny.

05:00 PM Christensen, John N.

AGE OF MVT MINERALIZATION IN THE CANNING BASIN, AUSTRALIA : Rb-Sr ANALYSIS OF SPHALERITE FROM THE BLENDEVALE DEPOSIT

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Recent work of Nakai et al. (1990, 1993) and Brannon et al. (1992) demonstrated that sphalerite may be dated using Rb-Sr isotopic systematics. This permits the direct dating of MVT and other sphalerite-bearing hydrothermal deposits that generally do not contain datable minerals.

The MVT Pb-Zn deposit at Blendvale, Western Australia, is situated on the northern margin of the Canning Basin on the Lennard shelf, and is hosted by the reefal facies of the Devonian (Frasnian) Pillara Limestone. Previous studies of carbonate cement stratigraphy concluded that MVT mineralization of the Lennard shelf limestones occurred in the early Carboniferous (McManus and Wallace, 1992). We have conducted Rb-Sr isotopic analysis of crushed and leached sphalerite separates, their fluid inclusions (as represented by water leachates from crushed sphalerite), and of host carbonate and sparry calcite. The sphalerites have from 0.2 to 0.3 ppm Sr and 0.2 to 1.2 ppm Rb. The $^{87}Rb/^{86}Sr$ of sphalerite ranges from 1.8 to 10.8, while the leachates have much lower $^{87}Rb/^{86}Sr$, from 0.09 to 0.26. Six sphalerites form an isochron indicating an age of 357±10 Ma (MSWD=7, $(^{87}Sr/^{86}Sr)_o$= 0.7128±6), in good agreement with the average age, 356±14 Ma, of the leachate/sphalerite pairs. A three point isochron consisting of a sphalerite sample, its leachate and associated host carbonate yields an age of 361±7 Ma. The leachates have an average initial $^{87}Sr/^{86}Sr$ of 0.7129±2 intermediate between two samples of mineralized limestone (0.7134 and 0.7120). Late sparry calcite has higher $^{87}Sr/^{86}Sr$, 0.7181. The initial $^{87}Sr/^{86}Sr$ of the sphalerites and leachates is higher than that of Paleozoic seawater indicating the fluids involved in mineralization have seen a source of radiogenic Sr. This is in contrast to the MVT deposit at Pine Point, Canada, where the sphalerite initial $^{87}Sr/^{86}Sr$ is essentially the same as the unaltered carbonate host rock. This study supports an early Carboniferous (Tournaisian) age for MVT mineralization in the Canning Basin.

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