№ 23248

A NUMERICAL SIMULATION OF THE CHEMICAL DEVELOPMENT OF LATERITE AND CHINA CLAY.

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Numerical modeling of laterite formation as a multicomponent system of rock and water reaction toward chemical equilibrium has been executed using program CHILLER, which calculates heterogeneous chemical equilibrium among gases, aqueous solutions and minerals upon changing of bulk composition, and (or) temperature. The design of the numerical simulations is based on field observations, analytical data and a few hypothetical processes. The modeling was carried out for three distinct geochemical environments: a) reaction of rain water with basalt b) reaction of acidic, reduced groundwater with basalt and c) oxidation of iron rich fluid from (b). These calculations were done at 25°C and atmospheric pressure.

The rain water-basalt reaction results in precipitation of gibbsite, goethite and manganese oxide at highest water/rock (w/r) ratio, and with decreasing w/r as more rock is consumed, the gibbsite is replaced by kaolinite, but goethite continued to precipitate in close association with kaolinite. The pH increases from 6.5 to 8, as the precipitation of these minerals and others (e.g. chlorite) continues. This model resembles direct atmospheric weathering that produce a residual accumulation of iron oxides together with kaolinite or gibbsite, but it does not produce a kaolinite-rich "pallid zone". Our second model shows that laterally migrating acidic, reducing ground water is necessary to produce a pallid zone (china clay) below an iron-rich hard pan. In this calculation the pH was set at 4 and the amount of bicarbonate ion in the aqueous system was set to three times the value for buffering by atmospheric fugacity of CO_2. The reaction produces pure gibbsite at highest w/r which gradually was replaced by kaolinite. Kaolinite alone precipitates over a substantial interval until talc, chlorite and K-feldspar start to form. The pH increases from 4 to 9. The third numerical model was designed to test oxidation of the ferrous-iron-rich groundwater produced in the second model by diffusion of oxygen from the atmosphere and/or by lateral flow of groundwater rich in ferrous iron to a topographic surface. Oxidation causes precipitation of goethite followed by manganese oxide. In this calculation pH decreases from 7.3 to 4.3. This drastic change in pH is due to oxidation of Fe^{2+} and Mn^{2+} which liberates hydrogen ion.

We conclude that normal rain and soil water can produce a red clay kaolinite and goethite association, but more reducing acidic water is needed to produce couplets of laterite and china clay.

№ 7128

PRESSURE-TEMPERATURE EVOLUTION OF BLUESCHISTS AND ECLOGITES FROM PINCHI LAKE, BRITISH COLUMBIA

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Blueschists and retrogressed eclogites occur along the Pinchi Fault Zone (near 54°30'N and 124°W) in British Columbia. This fault separates rocks of contrasting geologic histories and the blueschists and eclogites occur with ultramafic rocks as fault-bounded blocks. The eclogites occur as tectonic blocks, a few m in size; whereas blueschists occur in coherent km-sized tracts (= kst). Eclogites contain garnet-omphacite-rutile-quartz, with glaucophane, lawsonite, and titanite. Tectonic blocks of eclogite from two different localities have recorded different P-T histories. In one tectonic block P-T estimates for garnet inclusions in clinopyroxene and lawsonite (T ~ 565°C, P > 9 kbar) suggest that garnet and omphacite initially equilibrated outside of the stability field of lawsonite. A decrease in temperature, as recorded in garnet rims and matrix clinopyroxene, resulted in crystallization of lawsonite and other retrogressive minerals. In the second tectonic block, clinopyroxene inclusions in garnet suggest temperatures near 350°C (P>9.5 kbar) and garnet rims equilibrated with matrix clinopyroxene (stable with lawsonite) suggest temperatures near 435°C at P>~14.5 kbar ($P_S=P_{H2O}$). Blueschists (kst) contain glaucophane-lawsonite-quartz ± omphacite and, locally, talc-phengite. The mineral assemblages in these rocks suggest P-T conditions similar to those during retrogression of the eclogites, that is, T < ~400°C and P>~10 kbar.

№ 15408

GEOLOGY AND MINERALIZATION AT THE FIRST THOUGHT GOLD DEPOSIT STEVENS CO., WASHINGTON

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The First Thought gold deposit, on the southeast flank of First Thought Mountain, is genetically similar to epithermal gold deposits in the Republic mining district, which is about 45 km to the southwest. First Thought Mountain is the remnant of an eruptive center that was the locus of a variety of volcanic processes. Supporting evidence for a post-mineralization summit caldera which formed by passive magma withdrawal in the crater includes: (1) the elliptical topography of the mountain, (2) near-vent facies volcanic breccias, (3) vertically and laterally discontinuous volcanic units, (4) dikes and inward-dipping sedimentary rocks and curvilineaments visible on air photos that partially encircle the mountain, and (5) sub-regional and locally extensive hydrothermal alteration.

Formations at First Thought Mountain include the Sanpoil Volcanics (50 Ma) and the Klondike Mountain Formation (46 Ma). The Sanpoil consists of altered andesitic lava flows and flow breccias, tuffs, and volcaniclastic sedimentary rocks. The unaltered Klondike Mountain comprises three members: a sedimentary member, a pyroclastic member, and upper vitrophyric andesitic lava flows and flow breccias.

Mineralization/alteration at the First Thought deposit is of the low sulfur adularia-sericite type and is hosted by Sanpoil volcaniclastic siltstone, sandstone, and conglomerate. The deposit was formed by a low-temperature hot springs system in which local sealing and boiling and mixing of hydrothermal fluids with surface waters occurred. This is indicated by: (1) bedding-, fracture- and fault-controlled quartz stockwork veining with open spaces, drusy fillings, hydrothermal breccias, and healed fractures, (2) very fine grained, vuggy, crustiform quartz and laminated or colloform chalcedony, (3) lamellar calcite, (4) laumontite, kaolinite, illite-smectite, and mercury, (5) sericite, adularia, kaolinite, quartz, and pyrite associated with localized gold enrichment, and (6) rapidly diminishing gold and silver concentrations with depth.

Pervasive and locally intense hydrothermal alteration occurs as a zoned envelope around the veins. Alteration types include propylitic, chloritic, argillic, sericitic, silicic, and K-feldspar.

№ 16224

OBLIQUE STRIKE-SLIP FAULTING OF THE OREGON CASCADIA MARGIN: ROTATION AND SEGMENTATION OF THE FOREARC

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We present a new map showing the neotectonics and structure offshore Oregon, to be published by the state of Oregon at a scale of 1:500,000. We have investigated these structures using seismic reflection, GLORIA and SeaMARC 1A sidescan sonar, ALVIN submersible dives, and SeaBeam bathymetry. The map emphasizes active structures of the abyssal plain, accretionary wedge, and continental shelf. A structural boundary is present separating upper and lower slope structural domains in much of Oregon. Upper slope and some shelf structures trend WNW to NNW, while most lower slope structures parallel the north-south trend of the plate boundary. This boundary is a bathymetric and structural feature that may represent the seaward limit of a locked plate interface. Also notable are three confirmed and three probable WNW trending left-lateral strike-slip faults mapped on the abyssal plain and lower continental slope off northern and central Oregon between 43° 20' N and 45° 12' N. The three northernmost structures between 44° 40' N and 45° 12' N offset the basaltic crust of the Juan de Fuca Plate. Displacement extends into the overlying accretionary wedge of the North American Plate. These active structures are expressed in the continental slope as offsets and sigmoidal bends of fold axes, and en-echelon folds oriented along WNW trending shear zones. These faults are apparently subduction related structures, as their orientation and slip direction are inconsistent with the regional Juan de Fuca stress field as determined by earthquake focal mechanisms. This is supported by their youthful age and the lack of any evidence of reactivation of older structures. Development of these faults is consistent with a model of R' shears accommodating clockwise rotation of the seawardmost forearc driven by oblique subduction.

№ 21179

COGENETIC PERMO-TRIASSIC MELANGE AND BLUESCHIST TERRANES OF THE CENTRAL CORDILLERA, CALIFORNIA AND OREGON

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Permian to Late Triassic subduction-related elements of the central Cordilleran margin exposed in the Klamath and Blue Mountains can be divided into two types: inboard coherent blueschist complexes and outboard mélange belts. Blueschist complexes such as the Stuart Fork and parts of the Baker terrane exhibit generally coherent but highly deformed marine protoliths containing both Cr-Ep and Gln-Lws zone parageneses. Mineral assemblages, mica and amphibole compositions, and tectonite fabrics reflect entrainment of material to depths of 20-40 km. Variation in exposed apparent crustal levels in these regions is shown by: (1) northward succession of Ep to Lws; (2) local inclusion of eclogite blocks; and (3) partial incorporation within serpentinite-matrix mélange. White mica Ar cooling ages of ~220 Ma reflect synchronous uplift of these blueschist terranes as a coherent tract. In contrast, generally low-grade metasedimentary mélange occurs within the eastern Hayfork (EH) terrane of the Klamath Mountains and the central mélange belt of the Baker terrane (Elkhorn Ridge and Burnt River units). Mélange of the EH exemplifies this belt; it is characterized by incoherent and disrupted chert-argillite mélange and broken formation that hosts tectonic blocks of chert, quartz arenite, mica schist, limestone or marble, greenstone, layered amphibolite and blueschist. Where it is not thermally affected by mid-Mesozoic plutons, the mélange belt preserves evidence of high-P/T metamorphism as: (1) celadonitic matrix white mica; and (2) mafic blocks containing Ep-Ab-Hbl, Gln-Lws, and Prh-Act assemblages. Matrix white mica Ar cooling ages of ~260 Ma indicate this mélange may be as old as Early Permian.

These patterns are explained by a tectonic model in which the outboard, low-grade mélange units represent an accretionary complex associated with a deeper-level subduction complex, represented by the inboard, coherent blueschist belts, as part of a single convergent-margin system. The entire subduction system was active in Permian time, but the earliest cooling ages from the mélange belt suggest these rocks were uplifted to higher crustal levels before the more deeply entrained blueschists. Thus, the range in cooling ages is a direct result of diachronous stages in exhumation of the entire subduction system, and the mélange and blueschist terranes together are manifest of a broadly preserved Permo-Triassic subduction system. The regional extent of uplifted ~220 Ma coherent blueschists implies a major change in the subduction regime (such as plate reorganization leading to changes in subduction velocity and direction), and a virtual end to subduction along the Permo-Triassic belt as subduction was established further west.