MINERALOGICAL ABSTRACTS FROM SCIENTIFIC PAPERS PUBLISHED IN JAPAN,
Edited by the Abstracting Committee, Japan Association of Mineralogical Sciences

Ore Minerals and Economic Geology
Age Determination
104168 Li, W., Huang, Z. & Yin, M. Dating of the giant Huize Zn-Pb ore field of Yunnan Province, southwest China: Constraints from the Sm-Nd system in hydrothermal calcite.
Resource Geol., 57, 90-97, 4 figs, 1 table, 2007.

The Huize ore field, which is the most famous high-grade Mississippi Valley-type Zn-Pb ore field in China, consists of the Kuangshanchang and Qilinchang deposits. The Sm-Nd isotopic compositions of gangue calcite were analyzed to constrain the timing of mineralization. Eight calcite samples from the No. 6 orebody in the Qilinchang deposit have Sm and Nd concentrations of 1.82-25.93 and 15.25-79.02 ppm, respectively, and yielded an age of 225 ± 9.9 Ma with epsilon Nd = -10.6 and MSWD = 0.13. Five calcites from the No. 1 orebody in the Kuangshanchang deposit contain 2.37-2.90 ppm Sm and 8.18-16.85 ppm Nd, and yielded an age of 228 ± 16 Ma, with epsilon Nd = -10.6 and MSWD = 0.28. These two ages are close to the age of the Emeishan flood basalt, which is ca 255 Ma, and agree with the reported 40Ar/39Ar plateau and isochron ages of the native copper mineralization related to the Emeishan flood basalt in this region, which are 226-228 Ma. Moreover, previous study shows that the magnitude of uplift resulting from the Emeishan flood basalt is >1000 m. It indicates that the Kuangshanchang and the Qilinchang deposit formed during the same geological event and originated by fluid migration during uplift resulting from the Emeishan flood basalt.

(O-authors' abstract)


The Yinshan deposit in the Jiangnan tectonic belt in South China consists of Pb-Zn-Ag and Cu-Au ore bodies. This deposit contains approximately 85 Mt of the Cu-Au ores at 0.52% Cu and 0.8 g/t Au, and 84 Mt of the Pb-Zn-Ag ores at 1.25% Pb, 1.02% Zn and 33.2 g/t Ag. It is hosted by low-grade metamorphosed sedimentary rocks and mafic volcanic rocks of the lower Mesoproterozoic Shuangqiaoshan Group, and continental volcanic rocks of the Jurassic Erhuling Group and dacitic subvolcanic rocks. The ore bodies mainly consist of veinlets of sulfide minerals and sulfide-disseminated rocks, which are divided into Cu-Au and Pb-Zn-Ag ore bodies. The Cu-Au ore bodies occur in the area close to a dacite porphyry stock (No. 3 stock), whereas Pb-Zn-Ag bodies occur in areas distal from the No. 3 stock. Muscovite is the main alteration mineral associated with the Cu-Au ore bodies, and muscovite and chloride are associated with the Pb-Zn-Ag ores. A zircon sensitive high-resolution ion microprobe U-Pb age from the No. 3 dacite stock suggests it was emplaced in Early Jurassic. Three 40Ar/39Ar incremental heating mineral ages from muscovite, which are related to Cu-Au and Pb-Zn-Ag mineralization, yielded 179-175 Ma. These muscovite ages indicate that Cu-Au mineralization occurred at 178.2±1.4 Ma (2σ), and Pb-Zn-Ag mineralization at 175.4±1.2 Ma (Zr) and 175.3±1.1 Ma (Zr), which supports a restricted period for the mineralization. The Early Jurassic ages for the mineralization at Yinshan are similar to that of the porphyry Cu mineralization at Daxing in Jiangnan tectonic belt, and suggest that the polymetallic mineralization occurred in a regional transpressional tectonic regime.

(O-authors' abstract)


The U-Pb age data for seven standard zircons of various ages, from 28 Ma to 2400 Ma were obtained with an ablation pit size of 30 µm diameter. For 206Pb/238U Pb ratio measurement, the mean isotope ratio obtained on National Institute of Standards and Technology (NIST) SRM610 over 4 months was 0.9105 ± 0.0014 (n = 280, 95% confidence), which agrees well with the published value of 0.9106. The time-profile of Pb/U ratios during single spot ablation showed no significant difference in shape from NIST SRM610 and 91500 zircon standards. These results encouraged the use of the glass standard as a calibration standard for the Pb/U ratio determination for zircons with shorter wavelength (λ = 213 nm) laser ablation. But 206Pb/235U and 206Pb/238U ages obtained by this method for seven standard zircons are systematically younger than the published U-Pb ages obtained by both isotopic dilution-thermal ionization mass spectrometry (ID-TIMS) and sensitive high-resolution ion-microprobe (SHRIMP). Greater discrepancies (3-4% younger) were found for the 206Pb/235U ages for SL13, AS3 and 91500 zircons. The origin of the differences could be heterogeneity in Pb/U ratio on SRM610 between the different disks, but a matrix effect accuracy either in the ICP ion source or in the ablation-transport processes of the sample aerosols cannot be neglected. When the 206Pb/235U (= 0.2302) newly defined in the present study is used, the measured 206Pb/235U and 206Pb/238U ages for the seven zircon standards are in good agreement with those from ID-TIMS and SHRIMP within ±2%. This suggests that SRM610 glass standard is suitable for ICP-MS with laser ablation sampling (LA-ICP-MS) zircon analysis, but it is necessary to determine the correction factor for 206Pb/238U by measuring several zircon standards in individual laboratories.

(T. Takagi)

Gold Mineralization

In order to elucidate the formation mechanism of low-sulfidation epithermal gold deposit, the adsorption of [Au(S2O3)32⁻] (a model compound for gold(I) complex ion) on alumina gel (a model
compound for the aluminum-bearing minerals) and change in chemical state of $[\text{Au}(\text{S}_2\text{O}_3)^{2-}]$ after adsorption on the surface of alunite gel as investigated as a basic model experiment. In the pH range from 4 to 6, the amount of $[\text{Au}(\text{S}_2\text{O}_3)^{2-}]$ adsorbed on alunite gel decreased with increasing pH and decreased drastically between pH 6 and 7, and then approached zero above pH 8 at 30 °C. At 60°C, the amount of gold adsorbed above pH 7 was enhanced compared with that at 30°C. This adsorption tendency indicates that $[\text{Au}(\text{S}_2\text{O}_3)^{2-}]$ is mainly adsorbed by electrostatic interaction between negative charges of $[\text{Au}(\text{S}_2\text{O}_3)^{2-}]$ and positive charges of alunite gel because of its isoelectric point around pH 9. The chemical state of gold after adsorption of $[\text{Au}(\text{S}_2\text{O}_3)^{2-}]$ on alunite gel was examined using X-ray absorption near edge structure (XANES). The result showed that $[\text{Au}(\text{S}_2\text{O}_3)^{2-}]$ was spontaneously reduced to elemental gold even in the absence of specific reducing agents after adsorption on alunite gel. This reduction reaction might occur by two steps: (i) disproportionation of the adsorbed $[\text{Au}(\text{S}_2\text{O}_3)^{2-}]$ at the surface of alunite gel, and (ii) spontaneous reduction of the resulting gold(III) complex ions on the surface of alunite gel. The experimental results suggest that aluminum plays an important role in the concentration of gold(I) complex ions and subsequent reduction of gold during the formation of low-sulfidation epithermal gold deposits.

(Authors' abstract)


The Cretaceous hydrothermally altered rocks in the Gasa Island (Gasado), Korea, are classified into the following four alteration zones based on the alteration mineral assemblages: advanced argillic alteration (alunite-pyrophyllite-kaolinite-pyrite); sericite alteration (sericite-kaolinite-quartz); propylitic alteration (quartz-chlorite-calcite-pyrite-pyrrhotite); and supergene alteration (quartz). Alunite is an important weathering product in the advanced argillic zone occurred in two types; a massive or disseminated type and a vein type. Most of the massive or disseminated alunites are >50 μm in size, whereas the size of vein alunites is <20–30 μm. Alunite grain size is greater in the central part of disseminated or massive alunite, while it is smaller toward the margins. The gold content of each alteration zone is 21–2900 ppb, 15–88 ppb, 57–1730 ppb, and 2–231 ppb, respectively. The gold content of quartz veins developed in the alteration zones is 30–715 ppb. Gold is enriched in the minerals and rocks around faults and fissures, and is strongly concentrated in the advanced argillic alteration zone around faults. δ34S of alunites occurring in the advanced argillic alteration zone range from +16.5 to +3.9‰, although most are in a comparatively narrow range from +8.6 to +5.2‰. There is no difference between disseminated or massive and vein alunites. The δ34S of pyrites in the advanced argillic alteration zone are from +4.8 to −2.9‰. Oxygen and hydrogen isotopic values of alunites are from +8.5 to 0‰ and from −59.6 to −9.2‰, respectively. With an assumed temperature of 200°C, 6D and δ18O of hydrothermal solutions calculated for alunites are from −53.6 to −91.3‰, and from −2.4 to −8.1‰ for massive or disseminated alunites and from −6.6 to −10.9‰ for vein alunites, respectively. These data suggest that meteoric water dominated during the alunite formation. Isotopic data, geological setting, mineralogy, size of alunite and pure alunite composition (K end member) indicate that alunites of the study area were formed in the steam-heated environment of acid sulfate alteration. (T. Takagi)

104173 Murakami, H. Variations in chemical composition of clay minerals and magnetic susceptibility of hydrothermally altered rocks in the Hishikari epithermal gold deposit, SW Kyushu, Japan. Resource Geol., 58, 1–24, 15 figs, 4 tables, 2008.

Approximately 60% of the mineable auriferous quartz–adularia veins in the Honko vein system, the Hishikari Lower Andesite (HLA) occur in sedimentary rocks of the Shimanto Supergroup (SSG), whereas all the veins of the Yamada vein system occur in volcanic rocks of the HLA. In volcanic rocks of the HLA, hydrothermal minerals such as quartz, chloride, adularia, ilite, and pyrite replaced primary minerals. The amount of hydrothermal minerals in the volcanic rocks, including chlorite, adularia, ilite, and pyrite as well as the altered and/or replaced pyroxenes and plagioclase phenocrysts increases toward the veins in the Honko vein system. The vein–centered variation in mineral assemblage is pronounced within up to 25 m from the veins in the peripheral area of the Honko vein system, whereas it is not as apparent in the Yamada vein system. The hydrothermal minerals in sandstone of the SSG occur mainly as seams less than a few millimeters thick and are sporadically observed in halos along the veins and/or the seams. The alteration halos in sandstone of the SSG are restricted to within 1 m of the veins. In the peripheral area of the Honko vein system, chlorite in volcanic rocks is characterized by increasing in Al in its tetrahedral layer and the Fe/Fe+Mg ratio toward the veins within the volcanic rocks. The magnetic susceptibility of tuff breccia of the HLA varies from 21 to less than 0.01 × 10−3 SI within a span of 40 m from the veins and has significant variation relative to that of andesite (27–0.06 × 10−3 SI). The variation in the release alteration zone and has significant variation relative to that of andesite (27–0.06 × 10−3 SI). The variation in the release alteration zone is dominated in a narrow range from 0.3 to 0.2 × 10−3 SI. (T. Takagi)


The orebodies of the Sawayaerdun gold deposit, Southwest Tianshan, China, are controlled by a series of NE–NNE-trending, brittle–dextral shear zones. Twenty-four gold mineralized zones have been recognized in the deposit. Among these, the up to 4 km-long and 200 m-wide No. IV mineralized zone is economically the most important. The average gold grade is 1.6 g/t. Gold reserves of the Sawayaerdun deposit have been estimated to include approximately 37 tons and an inferred resource of 123 tons. Five stages of vein emplacement and hydrothermal mineralization can be petrographically distinguished: stage 1, early quartz stage, characterized by the occurrence of quartz veins; stage 2, arsenopyrite-pyrite-calcite stage, characterized by the formation of auriferous quartz veinlets and stockworks; stage 3, polymetallic sulfide stage, characterized by the presence of auriferous polymetallic sulfide quartz veinlets and stockworks; stage 4, antimony-quartz stage, characterized by the formation of stibnite–antimony–calcite–quartz veinlets; and stage 5, carbonate quartz stage. Stages 2 and 3 represent the main gold mineralization, with stage 4 representing a major antimony mineralization episode in the Sawayaerdun deposit. Two types of fluid inclusion, namely H2O–NaCl and H2O–CO2–NaCl types, have been recognized in quartz and calcite. Aqueous volume of the inclusions ranges from 125 to 340°C, and can be correlated with the mineralization stage during which the inclusions formed. Similarly, salinities and densities of these fluids range for each stage of mineralization from 2.57 to 22 equivalent wt% NaCl and 0.76 to 1.05 g/cm³, respectively. The δ34S of sulfides associated with mineralization range from −3.0 to +2.6‰ (mean = +0.1‰). The δ34S of dolomite and siderite from the Sawayaerdun gold deposit range from −5.4 to +0.0‰, possibly reflecting derivation of the carbonate carbon from a mixed magmatic/terrigenous source. Changes in physico–chemical conditions and composition of the hydrothermal fluids, water–rock exchange and immiscibility of hydrothermal fluids are inferred to have played important roles in the ore forming process of the
Sawayaerdun gold-antimony deposit. (T. Takagi)


The Bumo gold deposit is a low-sulfide quartz vein type deposit, located in the west of Hainan Island, China. Tectonically, the SW-NE-oriented Gezhen Ductile-Sharing Zone was largely attenuated in Bumo. It is hosted by gneisses and schists of Proterozoic age (locally called the Baohan Group), but the radiometric age of ores mainly is Jurassic-Cretaceous. The affinity with the Phanerozoic orogenic gold deposits is indicated by low salinity (2.4-10.3 wt% NaCl), intermediate temperature (150-300 °C) and appropriate δ18O value (approximately 7-11%). The gold metal tonnage within an area smaller than 1.0 km² in the gold belt II amounted to 11.59 t, with the average gold grades for the major Au quartz veins (7 and 8) in this belt of 52.7 and 71.1 g/t, respectively. This shows significant enrichment of gold and an unusual "nugget effect". A ring structure, mainly represented by ridges, valleys, dikes, big bull quartz veins and lithological borders or pertinent faults, marks the gold field, and its origin was linked to a possible magmatic diapir. It was viewed as macroscopic evidence that the dip angles of strata tend to decline gradually from deeper ones in the center area to nearly horizontal in the outskirts, and certain intrusion affiliated elements such as Bi, As and W are considerably abundant in soil samples. The area A (3.06 km²) in the outskirt of the ring structure or in northeastern Bumo and the area B (1.32 km²) in the center field or to the west of the gold belts I and II, were selected for the geochemical survey in a 50 × 50 m sampling grid. The analytical results of the samples from horizon C and in a ~80 mesh size showed that the average contents of Bi, As and W amounted to 0.55, 19.3 and 3.67 ppm in the area A (N=1225) and to 0.79, 68.3 and 4.14 ppm in the area B (N=529), respectively. This geochemical exploration led to the discovery of several Au quartz veins in both areas A and B, which also manifested an Au nugget effect (the average Au grades between 50 and 100 g/t) in spite of their limited scales (from 2 to 50 cm wide and from several meters to 15 m long). (T. Takagi)


Mesozoic epithermal gold deposits in eastern China are divided into calc-alkaline and alkaline magma-related gold deposits, and are also grouped as low-sulfidation, intermediate-sulfidation and high-sulfidation types, of which the first two predominate. These gold deposits are distributed in the Tianshan-Yinshan-Great Xing'anling Variscan fold belt of North China craton, Qinling-Dabie Indo-Sinian fold belt of Yangtze craton, and South China fold belt or Cathaysian block, from north to south along the eastern China continent. Most of the epithermal gold orebodies are hosted either in volcanic rocks or their related granitoids, and volcanic breccia pipes. These orebodies are mainly associated with adularia-chalcedony-sericite, and alunite-kalinite-quartz assemblages. These orebodies formed in four mineralization pulses at 175, 145-135, 127-115, and 110-94 Ma. The first three pulses correspond to the post-collapse period between the North China and Yangtze cratons, an extension period during late-stage rotation of the principal compressional stress from N-S to E-W, and a dramatic thinning period of the lithosphere, respectively. The last mineralizing pulse was the result of another extension in South China. Although the mineralizing pulses occurred at different times, they all occurred in extensional settings and were accompanied by crust and the mantle interaction.

(Autors' abstract)


In the Sawuershan region, north Xinjiang, NW China, there are two gold deposits in mining, namely the Kuoezhenkuola and the Buerkesidai deposits. Gold ores at the Kuoezhenkuola deposit occur within Carboniferous andesite and volcanic breccias in the form of gold-bearing quartz-pyrite veins and veinlet groups containing native gold, electrum, pyrite, pyrrhotite and chalcopyrite. Gold ores at the Buerkesidai deposit occur within Carboniferous tuffaceous siltstones in the form of gold-bearing quartz veinlet groups and altered rocks, with electrum, pyrite and arsenopyrite as major metallic minerals. Both gold deposits are hosted by structurally controlled faults associated with intense hydrothermal alteration. The typical alteration assemblage is sericite + chlorite + calcite + quartz, with an inner pyrite-sericite zone and an outer chlorite-chalcedyne-pelite zone between orebodies and wall rocks. δ18O values (0.3-1.3‰) of pyrite of ores from Kuoezhenkuola deposit are similar to those (0.4-2.9‰) of pyrite of ores from Buerkesidai deposit. δ34S values (1.1-2.8‰) of pyrite from altered rocks are similar to δ34S values of magmatic or igneous sulfide sulfur, but higher than those from ores. 206Pbl207Pb, 204Pb/204Pb and 208Pb/204Pb data of sulfide from ores range within 17.72-18.56, 15.34-15.61, and 37.21-38.28, respectively. These S and Pb isotope compositions imply that ore-forming materials might originate from multiple, mainly deep sources. He and Ar isotope study on fluid and inclusions of ores from different areas, namely the core, transitional and peripheral parts, of the two deposits indicates that ore-forming fluids were NaCl-rich (salinity 57-59 wt%), intermediate temperature (150-300 °C) and appropriate δ18O value (approximately 7-11%). The gold isotope signatures manifest a Au nugget effect (the average Au grades between 50 and 100 g/t) in spite of their limited scales (from 2 to 50 cm wide and from several meters to 15 m long) in the Sawuershan region.


A variety of spatial geological data were compiled, evaluated and integrated to produce a map of potential Au and Ag deposits in the Gangreung area, Korea. The empirical approach assumes that all deposits shared a common genesis. The method consists of three main steps: (i) identification of spatial relationships; (ii) quantification of such relationships and (iii) integration of multiple quantified relationships. A spatial database containing Au and Ag deposits, topographic, geologic, geophysical and geochemical data was constructed using a GIS. The factors relating to 103 Au and Ag mineral deposits are the geological data such as lithology and fault structure, geochemical data including the abundance of Al, As, Ba, Ca, Cd, Co, conductivity, Cr, Cu, Eh, Fe, HCO₃⁻, K, Li, Mg, Mn, Mo, Na, Ni, Pb, pH, Si, Sr, V, W, Zn, C1⁻, C, PO₄³⁻, NO₃⁻, SO₄²⁻, and geophysical data including Bouguer and magnetic anomalies. Using the constructed spatial database, the relationships between mineral deposit areas and related factors are identified and quantified by probabilistic and statistical modeling; that is, likelihood ratio, weights of evidence and logistic regression models. All the factors were combined to produce a map of the regional mineral potential using the overlay method in a GIS environment. The mineral potential map was then verified by comparison with known mineral deposits. The verification results give respective accuracies of 82.52%, 72.45% and 81.60% for the gold and silver deposits, respectively.
The Kuorzhenkuola gold deposit area, the Sawur gold belt in Xinjiang, China features an elliptical caldera where the gold deposit lies. The mineralization at the gold deposit is not controlled by the EW-striking regional fault as previously assumed, but by a caldera fracture system locally superimposed by regional faults; the host rocks are andesites and dacites of the Carboniferous Heishantou Group rather than the crypto-exhalative breccia of the Devonian Sawurshan Group. The ore-forming fluids are characterized by low-temperature and low salinities estimated from fluid inclusion microthermometry. Quadrupole mass spectrometry indicated a CO$_2$-bearing fluid. Inductively coupled plasma mass spectrometry of the fluid inclusions indicated high Cu (average 70 ppm) for the Au mineralization, whereas the host rocks have low Cu (average 33 ppm), indicating that Cu of the ore-forming fluids originated from magmatic fluid rather than the volcanic rocks. Pb isotopes of ores and host volcanic rocks indicate a similar, mixed source and some Pb could be sourced from the volcanism. This implied that magmatic fluids transported and precipitated within the caldera fracture system could play an important role in the Au mineralization process. Stratagem EH4 soundings over six parallel traverses perpendicular to the mineralized trend showed that the caldera fracture system could extend for approximately 900 m in the dip direction at the center of the caldera, an indication of the presence of potential deep mineralization under the surveyed area. Detailed modeling of the Stratagem EH4 sounding images provided well defined targets for test drilling. Subsequent test drilling on one of these targets, which extends down 850 m at an angle of 87°, returned encouraging results because four core intercepts of gold ore bodies at down-hole depths of 40.5–42.0 m, 70.5–73.5 m, 357.0–385.5 m, and 384.5–385.5 m and a long interval gold mineralized body (0–720 m) were encountered. (T. Takagi)


In the Asachinskoe epithermal Au–Ag deposit, a representative low-sulfidation type of deposit in Kamchatka, Russia, there are approximately 40 mineralized veins mainly hosted by daciteandesite stock intrusions of Miocene–Pliocene age. Wall-rock alteration at the bonanza level (170–200 m above sea level (a.s.l)) consists of the mineral assemblage of quartz, pyrite, albit, illite, and trace amounts of smectite. Mineralized veins are well banded with quartz, adularia and minor illite. Mineralization stages in the main zone are divided into stages I–IV. Stage I is relatively barren quartz–adularia association formed at 4.7 ± 0.2 Ma (K–Ar age). Stage II consists of abundant illite, Cu-bearing cryptomelane and other manganese oxides and hydroxides, electrum, argentite, quartz, adularia and minor rhodochrosite and calcite. Stage III, the main stage of gold mineralization (4.5–4.4 ± 0.1–3.1 ± 0.1 Ma, K–Ar age), consists of a large amount of electrum, naumannite and Se-bearing polybasite with quartz–adularia association. Stage IV is characterized by hydrothermal breccia, where electrum, tetrahedrite and secondary covellite occur with quartz, adularia and illite. The concentration of Au–Ag in ores has a positive correlation with the content of K$_2$O + Al$_2$O$_3$, which is controlled by the presence of adularia and minor illite, and both Hg and Au also have positive correlations with the light rare-earth elements. Fluid inclusion studies indicate a salinity of 1.0–2.6 wt% NaCl equivalent for the whole deposit, and ore-forming temperatures are estimated as approximately 160–190°C in stage III of the present 218 m a.s.l. and 170–180°C in stage IV of 200 m a.s.l.

The depth of ore formation is estimated to be 90–400 m from the paleo-water table for stage IV of 200 m a.s.l., if a hydrostatic condition is assumed. An increase of salinity (>C$_{NaCl}$ > 0.2 wt%) and decrease of temperature (<T ≈ 30°C) within a 115 m vertical interval for the ascending hydrothermal solution is calculated, which is interpreted as due to steam loss during fluid boiling. Ranges of selenium and sulfur fugacities are estimated to be log/Se$_2$ = −17 to −14.5 and log/S$_2$ = −15 to −12 for the ore-forming solution that was responsible for Au–Ag–Se precipitation in stage III of 200 m a.s.l. Separation of Se from S–Se complex in the solution and its partition into selenides could be due to a relatively oxidizing condition. The precipitation of Au–Ag–Se was caused by boiling in stage III, and the precipitation of Au–Ag–Cu was caused by sudden decomposition and boiling in stage IV. (T. Takagi)


The Sibutad gold deposit has gold associated in quartz veins. The most important of these is the Lalab orebody, which contains ore-grade gold, predominantly, in milky quartz veins and veinlets. Here, alteration quartz and fine-grained crystalline clear and milky quartz were formed from hydrothermal fluids in three stages, namely stages I, II and III. Fluid inclusion microthermometry was carried out on stage I milky quartz, stage II fine-grained alteration quartz and stage III milky quartz ± barite veins and veinlets. Homogenization temperatures (TH) are >248°C in stage I, 214–232°C in stage II and 186–239°C in stage III. These fluid inclusions have salinity between 1 and 2 wt% NaCl equivalent. In terms of gold assay, stage I drill-core samples have gold grades of 0.53–0.76 g/ton Au, stage II samples have 1.12–3.70 g/ton Au and stage III samples have 9.06–23.88 g/ton Au. This correlation suggests that gold was precipitated from the stage II and III fluids. (Authors’ abstract)


The evaluation of the relatively fresh host rock and altered rock samples associated with the Pantangan Gold System exposed in Mount Mariveles, Bataan yield several notable observations that are useful in pinpointing potential gold pathfinder elements. Geochemical and petrologic analysis showed that the altered rocks can be subdivided into rocks that underwent propylitic alteration (group 1), argillized rocks with silica contents similar to those of the fresh host rocks (group 2), argillized but not strongly silicified rocks (group 3) and argillized and strongly silicified rocks (group 4). Selected element ratio patterns in the altered rocks and gold concentrations in gold-bearing quartz veins vary between the rock groups. Moreover, mass balance calculation also reflected the geochemical observations pertaining to the gains and losses of SiO$_2$, Fe$_2$O$_3$– MgO, CaO + Na$_2$O and K$_2$O, which are believed to be chemical reactions (i.e. breakdown of plagioclase, silica hydration or leaching, sulfide and calcite formation) caused by the influx of hydrothermal fluids. (Authors’ abstract)