**Japan Geoscience Union Meeting 2011**
(May 22-27 2011 at Makuhari, Chiba, Japan)


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# Major and trace elements geochemistry of Co-rich ferromanganese crust from the #5 Takuyo Seamount, northwestern Pacific

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Large amount of hydrogenetic cobalt-rich ferromanganese (Fe-Mn) crusts are known to occur on the surface of seamounts or ocean plateaus in the Pacific Ocean. The Fe-Mn crust is one of the most promising seafloor mineral resources enriched in not only Cu, Co, and Ni but also REE and PGE. Here we report the geochemical features of the Fe-Mn crusts collected from the #5 Takuyo Seamount, which is located 120 km west from the Minami-torishima Island, northwestern Pacific.

The amounts of trace elements in the crusts are controlled by the $MnO_2$(or $Fe_2O_3$) content: Those of Ni, and Cu are roughly proportional to the $MnO_2$ contents, while REE, especially HREE, show strong positive correlation with the $Fe_2O_3$ content. The Mn/Fe ratios decrease toward the surface of the crusts in all samples taken at various water depths between 965m and 2987m. The Fe/Mn ratios of crust samples from the surface part within 3 mm tend to be higher along with the increase of water depths, which is similar to the vertical profile of dissolved oxygen amount in the Pacific Ocean. The crusts are characterized by high total REE contents (La-Lu) varying from 1267 to 2168 ppm (average 1660 ppm). PAAS-normalized REE patterns show flat patters with conspicuous positive Ce anomalies. We believe that the Fe-Mn crusts are promising alternative as the source of HREE because of the high REE contents and the large ore reserve.

Keywords: ferromanganese crust, minor elements, #5 Takuyo Seamount, REE, resource evaluation

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# Mineralization of Miyazaki Ore Deposits, Miyagi Prefecture, Japan -Especially about Bonten Gypsum Deposit-

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Several gypsum, manganese, zinc-lead deposits are distributed in the Miyazaki mining area, northwest of Miyagi Prefecture. The Bonten gypsum deposit is a sedimentary type and is embedded in the rhyolitic tuff of early Miocene age. The rhyolitic tuff in the vicinity of the deposit dips 7-10 degrees south and is covered with tuffs containing rounded andesitic pebbles (Anzai, 1955). The center of the deposit is affected by remarkable clay alteration and contains satin spar gypsum up to 15cm. The Bonten gypsum deposit, Bonten manganese deposit of early Miocene and Yunokura Pb-Zn deposit are focused in this study.

In this study we collected ore and rock samples from each deposits and outcrops and analyzed by XRD, microthermometry of fluid inclusions, and EPMA to elucidate the mineralization of this area.

The clay ore of the Bonten gypsum deposit contains quartz, pyrite, sphalerite, and sericite, halloysite. Although pyrite, analcime, mordenite, smectite is detected in tuffaceous host rocks around the deposit, they are not detected in rocks far from the ore deposits. Fluid inclusions of gypsum indicate 50-60 degrees homogeneous temperature and 4.9-3.2 wt.% NaCl equivalent. Judging from the surrounding geological setting, pressure revision to the temperature is very low, and it is thought that this area has affected by the thermal spring activity of about 70 degrees or less. This fact is in accordance with that no anhydrite is detected in this area (Kinoshita, 1924). Calcium may be originated from rocks in the vicinity during the process of smectite alteration. On the other hand, about the origin of S, we have two ideas; 1, if this deposit has occurred during shallow marine sedimentation, S originates in seawater, 2, if this deposit occurred at secondary alteration after sedimentation, it is suggested that S originates in thermal spring water. (leaching of pyrite in the lower formation)

The Yutorinuma Formation which overlies the Bonten gypsum deposit contains the Bonten manganese deposit. Pyrolusite and hematite which are known to be indicators of oxic environment are detected from this ore deposit. The Yunokura sulfide deposit embedded in the Nagashida Formation which overlies the manganese deposit. This deposit produces sphalerite, galena, chalcopyrite, pyrite, and barite. The $T_H$ of fluid inclusion from these samples is 120-200 degrees. Hydrothermal alteration zones are sporadically occurred in this area. These facts suggest that the Miyazaki mining area have widely received multiple and different thermal (spring) activities.

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# Oxygen isotopic variation of vein quartz at the Toyoha deposit: a reconnaissance study

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The Toyoha deposit, an epithermal polymetallic vein-type deposit, was formed by two-stages mineralization. The veins in the northwestern part of the deposit were formed early mineralization (early-stage veins), while southeastern veins were formed by late mineralization (late-stage veins).

The oxygen isotope ratios of vein quartz were obtained for major veins. Delta $^{18}O$ values of quartz from early-stage veins (Rebun, Rishiri, 3rd Chikugo, Bizen and Tajima veins) are +2.8 to +5.5 per mil, and those of late-stage veins (Izumo, Sorachi, Iwami, Shinano veins) are +3.3 to +8.8 per mil. The delta values of late-stage veins are higher than those of early-stage veins. Calculated delta $^{18}O$ values of ore-forming fluid responsible for the veins are -9.3 to -4.2 per mil for early-stage veins, and -7.2 to +1.6 per mil for late-stage veins. These values are between local meteoric water (-11 per mil) and primary magmatic fluid (+5.5 to +9.5 per mil). The variation of delta values of ore-forming fluid can be explained by the difference of mixing ratio of meteoric water and magmatic fluid.

Previous mineralogical and geochemical studies have revealed that ore-forming conditions for early-stage and late-stage veins were distinctive. Early-stage veins were formed under relatively high oxygen fugacity, and ore-forming fluid was supplied by magnetite-series magma. Late-stage veins were formed under reduced condition, and have polymetallic nature. Difference of ore-forming conditions was explained by the model, where magnetite-series magma responsible for early-stage veins assimilated sedimentary rock then changed to reduced nature and supplied ore-forming fluid of late-stage veins (Ohta, 1995). If assimilation of sedimentary rock occurred, delta $^{18}O$ values of bulk rock would shift to heavier. Then oxygen isotopic data of this study supports the model proposed by Ohta (1995).

Keywords: oxygen isotope, Toyoha deposit, ore-forming fluid, quartz

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# PGE-rich clays in a mantle peridotite xenolith from Avacha volcano, the southern Kamchatka arc

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Platinum-group elements (PGE) have strongly refractory features within the mantle peridotite/melt system, and favor sulfides or metals (such as the earth's core). In addition, these PGE are not mobile during weathering and/or low temperature alteration processes. We found unusually high-Ni, Fe clays in a highly metasomatized mantle peridotite xenolith (sample #159) from Avacha volcano, the southern Kamchatka arc. The sample #159 contains Ni-rich spots, composed of mantle minerals with high-Ni contents: NiO contents of olivine, orthopyroxene, and chromian spinel is up to 5.3 wt%, 1.1 wt% and 1.1 wt%, respectively, there. The high-Ni, Fe clays are located at the center of the Ni-rich spot, and the Ni content of minerals decreases from the center outward. The high-Ni, Fe clays are brownish-yellowish in color under the microscope. Some of the clays are also quite rich in S (? 66,000 ppm). The Ni/(Fe+Ni) atomic ratio of the clay is highly changeable (0-0.7), and does not show any correlation with the S content. However some incompatible trace elements (Nb, Sr, Zr and Ti) are strongly depleted in the high-Fe, Ni clays, their rare earth element features are similar to those of Avacha silicic glasses and/or the host andesite. In addition, some clays show extremely PGE enriched features, and the concentrations of Os, Ir and Ru in the clays are 106 times higher than the chondrite values. Geochemical features of minerals around the high-Ni, Fe clay clearly indicate that the clays are an alteration product from the metasomatic agent that drastically enhanced the Ni content of surrounding minerals. Possible candidate of the metasomatic agent is sulfide, but we can deny the possibility because there is no Ni enrichment halo around intact sulfides in sample #159. We propose that the high-Ni, Fe clays were peculiar silicate melt or silicate-bearing aqueous fluid with high concentrations of Ni, Fe, S and PGE, and it possibly plays an important role in mobilization of transition elements and PGE within the mantle wedge.

Keywords: platinum-group elements, transition elements, peridotite xenolith, mantle wedge

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# Geochemical, Petrological and Environmental Tectonomagmatic dykes in north of Rabor (Southeast of Iran)

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The study area is inclusive some dykes located in the Kerman province, 10 km north of Rabor. Geologically the area is in the Central Iranian, located volcano-plotonic zone of Urumieh- Dokhtar and southeastern Dehaj- sarduiyeh belt. These dykes have partly ordered array with process dominant north- south and are thickness intermediate 4 meters. These rocks are andesite and dacite in composition with porphiric texture at age Miocene- Pliocene that intruded in the Eocene pyroclastic rocks and Miocene sedimentary units. phenocryst minerals and basic constitutive this rocks are composed of plagioclase, amphibole, biotite and somewhat pyroxene. These minerals somewhen attendants with vitrophyr are in background these rocks. Phenocryst this rocks special plagioclase minerals show disequilibrium textures such as oscillatory zoning, soluble and sieve texture. Peer this disequilibrium structures more due pressure decrease and changing pressure water vapor is in the season those form. In microscopic section dominant texture porphyric this rocks, but in those may observe microlitic porphyric, hyalloporphyritic and microgranolar textures. Based on geochemical studies, denote that inverse increase content silica oxide, alkali element oxides, contents Rb, Ba, Sr, Pb, elements increased and other oxides and V, Y, Co, Ni, elements decreased. Changing positive Ba, Rb, U, Th, Pb, Ce, Cs, La and Sr elements, negation V, Cr, Ni, Yb elements this rocks than chondritic normalization and primitive mantle normalization may due work fluid subduction zone and or differentiation minerals such as pyroxene and hornblende. Beside negation anomaly Nb and Ta elements this rocks probably product those contamination with crustal material. Changing increasing ratios Th/Zr, Ce/Y with stable ratio Zr/Nb in the rocks, probably due efficacy dehydration slab subduction is in the mantle wedge metasomatism. Geochemical instance various such as high LREE contents this rocks rather than HREE contents and high LILE/HFSE ratios show those probably formed in the seat continental margin correlate subduction and melting mantle wedge due dehydration slab subduction. Field survey, geochemical and structural this dykes show that probably fractions result activity Sarduiyeh and Dehshir- Baft fault adequate in those forming.

Keywords: Iran, Kerman, Rabor, Petrology, Geochemistry, Andesitic dykes

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# Geology, mineralization and alteration in Nehbandan Mahor Mine, West Lut Block of Iran

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The study area is situated within the Lut Block 130 Km east of Nehbandan. The oldest exposed rocks are cretaceous limestone and conglomerate. Dacite-rhyodacite lava and pyroclastic rocks erupted over oldest rocks. Volcanic activates in Tertiary time consist of andesite, trachyandesite, basalt-andesite, dacitic tuff and rhyolite in composition. Plutonic rocks mainly consist of granite, diorite, granodiorite and monzonite. Volcanic rocks are K-rich calc-alkaline. The pattern of spider diagram in comparison with mantle, they are enriched in Cs, Ba, Rb, and Zr and depleted in Nb, K and Ti. In this area alteration zones are silicified, propylitic, sericitic and argillic. Mineralization associated with volcanic rocks show signs of Ag, Au, Zn, Pb and Cu geochemical exploration anomalies.

Keywords: Nehbandan, Geochemical exploration, Alteration, Mineralization, Mahor, Iran