SCG61-01   Room:311   Time:May 2 09:00-09:15

Pulsed granitic crust formation revealed by comprehensive SHRIMP zircon dating of the SW Japan granitoids

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The origin of continental crust is a fundamental question in Earth's evolution. Granitoids, its volcanic equivalents, and metamorphic and sedimentary rocks with granitic compositions, are the main components of the upper continental crust. It is therefore important to understand the geodynamic settings in which juvenile granitic magma is generated from mantle-derived sources. Convergent plate margins, such as the Mesozoic circum-Pacific orogenic belts, are regarded as one of the plausible candidates for the post-Archean continental crust formation, as they are associated with abundant calc-alkaline I-type batholiths. However, the fundamental tectonic processes that triggered these voluminous granitic crust formations in the Mesozoic have remained largely unresolved due to the lack of precise temporal constraints on the granitic magmatism. We are currently undertaking a comprehensive geochronological study of the granitic batholith exposed in the Southwest Japan Arc, which is typical of the Mesozoic circum-Pacific orogenic belts utilizing high-precision zircon U/Pb geochronology.

In order to precisely determine the space-time distribution of the granitic magmatism that occurred in the SW Japan Arc during the Mesozoic, we have used the zircon U/Pb method to date a comprehensive suite of granitic rocks from the Chugoku Region in the SW Japan. Contrary to the results previously obtained using conventional geochronological methods, which suggested that the magmatism occurred gradually from ~100 to ~50 Ma, with the plutons forming over long time intervals, the newly obtained zircon ages reveal three clear pulses of granitic crust formation at 85, 60 and 35 Ma separated by 25 million year intervals. The 85 Ma magmatism was the most voluminous and was distributed in a broad zone that extends ~120 km across-strike, whereas the magmatism at 60 and 35 Ma were focused on the northern margin of the SW Japan Arc. Furthermore, the granitic magmatism at 85 Ma involved sediment-incorporated, ilmenite series granitic rocks, while the magmatism at 60 and 35 Ma involved more juvenile, mantle-derived, magnetite series rocks. Thus, not only did the granitic magmatism in SW Japan occur in pulses, there was also a spatial and compositional transition in the magmatism through time. This can be best explained by enhanced subduction zone magmatism during the Mesozoic, rather than the previously proposed model in which it was suggested that the granitic crust was formed by the subduction of a mid-ocean ridge on the Pacific Plate during the Middle Cretaceous.

SCG61-02   Room:311   Time:May 2 09:15-09:30

Petrology and zircon geochronology of the Hikami Granitic Rocks in south Kitakami Mountains,Japan

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The Hikami Granites,pre-Cretaceous older granitic complex of the South Kitakami Terrane,has long been controversial on their age of intrusion. Since unconformable relationship between the granites and the Silurian formation was shown by Murata et al.(1974). However CHIME age determinatin for the grainites (Adachi et al.,1994),indicates Silrian to Permian age.We examined the zircon U-Pb ages of 13 samples from the Hikami Granitic Rocks, and solidification age of around 450Ma were obtained.

Bulk rock chemical compositions of the Hikami granites were compared with Paleozoic granitic rocks in Japan. Petrochemical similarity between Hikami Granitic Rocks and the granitic rocks in the Kurosegawa Belt is consistent with the correlation between the South Kitakmi and Kurosegawa Belts.

Keywords: HikamiGranites, zircon, U-Pb age, Petrochemistry

SCG61-03　　　　　　　Room:311　　　　　　　Time:May 2 09:30-09:45

Sr-Nd-Pb-Hf isotopic variations of Cretaceous to Paleogene granitic rocks from northeast Japan

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The Japanese Islands represent a segment of a 500 Ma old subduction related orogen developed along the western Pacific convergent margin, and most tectonic units are composed of late Paleozoic to Cenozoic accretionary complexes and their high P/T metamorphic equivalents (e.g., Maruyama, 1997; Isozaki et al., 2010). Maruyama (1997) described the formation of the Japanese Islands has been taken as the standard model for an accretionary orogeny. He also stated that the most important cause of the orogeny is the subduction of an oceanic ridge, by which the continental mass increases through the transfer of granitic melt from the subducting oceanic crust to the orogenic belt. On the other hand, Jahn (2010) described that the subduction-accretion complexes consisting of granitic and sedimentary rocks in southwest Japan are composed mainly of recycled old continental crust. Kagami et al. (1999) described that the Honshu Arc can be divided into three groups based on their Sr-Nd isotope characteristics: the Kitakami, North (Abukuma belt), and South (Ashio/Mino belts) Zones, in order of increasing Sr isotopic enrichment, with Nd isotopic depletion from NE to SW. We present Sr-Nd-Pb-Hf isotopic ratios for granitic rocks in northeast Japan.

Sr-Nd-Pb-Hf isotopic study are made for granitic rocks from the Kitakami belts (Kitakami Mountains), the Abukuma belts (Shirakami Mountains, Obonai area, Taihei Mountain, Sekiryo Mountains, and Abukuma Mountains), and the Ashio/Mino belts (Okutone area, Tadami area, Okutadami area, Taisyaku Mountains, and Ashio Mountains). Newly isotopic data from these granitic rocks show increasing enrichment of crustal component in order of the Kitakami, Abukuma, and Ashio/Mino belts. Multi-isotope plots of these rocks indicate that the trend in variation could result from the mixing of depleted and enriched components. The depleted component is likely to originate from the magmatic flux related to the Lower Cretaceous ridge subduction. On the other hand, the mixing model of subducted sediments and depleted mantle cannot explain the variation of Nd-Hf isotopic compositions of granitic rocks. The enriched component requires existence of a reservoir with low Hf initial isotope ratio, which is considered to be zircon-rich sediment derived from old continental protolith (Chauvel et al., 2008). In addition, the granitic rocks in Kitakami zone shows rather different trend from the granitic rocks in other districts. It can be explained by the hypothesis that the granitic rocks in the Kitakami zone were derived from the mixing of mantle component with enriched end menber of lower Hf initial isotope ratio. This model is consistent with the fact that the Kitakami zone is characterized by the occurrence of adakitic rocks related to Lower Cretaceous ridge subduction.

Keywords: Northeast Japan, granite, Sr-Nd-Pb-Hf isotope, petrochemistry

Garnet-bearing acidic igneous bodies in Mt. Kenashi-yama area, Fujikawaguchiko-machi, Yamanashi, Japan

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Introduction The gernet-bearing quartz porphyrite body in Mt. Kenashi-yama area Fujikawaguchiko-machi, Yamanashi, Prefecture was described by Katada (1956). On the other hand, there are many reports on garnet-bearing boulders in this area (Togawa et al., 1996; Togawa et al., 1997; Matsubara et al., 2008; Tamura et al., 2010).

On the detailed field works, we recognized three groups of garnet-bearing acidic igneous bodies in this area.

Geology The studied area is in the northern end of Izu-Bonin Arc, and is located east side of Misaka group, middle to late Miocene.

Lithology Three garnet-bearing acidic igneous bodies are recognized, which are named A, B and C groups.

[A group (lava flow(?))] This group exists in 1,100m to 1,200m above sea level, and is located from WSW to ENE over 2km long. The rock consists of quartz (10%-20%, md : maximum diameter = 5mm), feldspar (10%-25%, md = 4mm), garnet (1%, md = 3mm) and groundmass(60%-65%). The rock of A group shows high dense appearance.

[B group (volcanic ash(?))] This group exists at 1,200m, and this group may be exist along above the A group. This group can be assumed as garnet-bearing volcanic ash, because this group contains volcanic glasses (at under microscope) and rock fragments (If B group is not volcanic ash, this group may be the weathered zoon of A group). The B group consists of quartz (10%, md = 5mm), garnet (1%, md = 3mm) and clay matter 80%.

[C group (dike)] This group exists in 1,300m to 1,400m, and is located from WSW to ENE, over 3km long. The rock is little fragile, and consist of quartz (3%-20%, md = 4mm), feldspar (3%-20%, md = 3mm), garnet (0.1%, md = 3mm), hornblende (1%, maximum length = 9mm) and groundmass (65%-85%).

Chemical analysis Representative samples of each groups are analyzed by X-lay fluorescent analysis on 10 major elements. The SiO_2 contents of three groups are 72wt%-76wt%. It mean that these rocks are classified into rhyolite according to alkali-SiO_2 diagram (Le Bas, et al., 1986). There are slightly high in Na_2O, and slightly low P_2O_5 than Tanzawa Hosokawadani rhyolite (Yamashita, 1997).

Discussion and Consideration It can be assumed that three groups of garnet bearing acidic igneous bodies are recognized in Mt. Kenashi-yama area. They are located along WSW-ENE direction 2-3km long. A, B and C groups are possibly lava flow, volcanic ash and intrusive rock, respectively. All of them may be classified into garnet-bearing rhyolite.

Keywords: garnet, quartz, feldspar, rhyolite, Mt. Kenashi-yama, Fujikawaguchiko-machi

SCG61-05   Room:311   Time:May 2 10:00-10:15

Two types of websterite from the Ust'-Belaya ophiolite, Far East Russia: Origins and implications

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The Ust'-Belaya ophiolite is located in the Koryak Mountains, Far East Russia. We report two types of websterite in the mantle section of the ophiolite.

The lithology of the mantle peridotites from the ophiolite is variable from very fertile lherzolite to moderately depleted harzburgite. The mineral chemistry of the very fertile lherzolite shows similar signature to those of the subcontinental peridotite. The two types of websterite (type1 and type2) occur in them as dikes/veins. Type1 is composed of brownish colored cpx, opx and Al-spinel. On the other hand, type2 is composed of green colored cpx, opx and Cr-spinel.

Type2 websterite is similar to those reported from many other ophiolites. Websterites, which are characterized by extremely aluminous spinel similar to the type1 websterite, are never found in ophiolitic peridotites but are described in passive margin peridotites (e.g. Zabargad Island in Red Sea and Iberia Abyssal plain peridotites). These websterites are generally interpreted as high-pressure cumulates and the host peridotites are considered as fragments of subcontinental mantle.

The mantle section of the Ust'-Belaya ophiolite represents, at least partly, fragments of subcontinental mantle. The two types of websterite might be related to two different magmatisms in two different tectonic settings; type1 is formed former subcontinental to oceanic environment and then type2 is formed later oceanic to arc environment.

Keywords: Ust'-Belaya ophiolite, websterite, subcontinental mantle

SCG61-06 Room:311 Time:May 2 10:15-10:30

Field geological considerations on the formation mechanism of platy joints in lava flows

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Columnar jointing and platy jointing are characteristic types of jointing in volcanic rocks. The origin of columnar joints has been discussed for centuries, and at the present day it is considered that they are the result of cooling and contraction of lava (Aydin and DeGraff, 1988). However, platy joints have far less attracted researchers than columnar joints and their formation mechanism is still controversial. Platy joints can develop in thick ($>$100 m) and voluminous lava flows which have glassy margins such as "flood andesite" in Kyushu, Japan (Nagao et al., 1995) and ridge-forming lava flows at Mount Rainier (Lescinsky and Sisson, 1998), probably reflecting stress distribution or physical property within solidifying lava. Previous studies attributed formation of platy joints (sheeting joints) to late stage shear of lava flow and/or microlite orientation (Lescinsky and Fink, 2000), deflation of flow (Spörli and Rowland, 2006) or both flowage and shrinkage of lava (Bonnichsen and Kauffman, 1987). Although absolute evidence for the origin of platy jointing has not been found, restraining of internal lava by solidified flow margin would be an important factor in any case and density (volume ratio of crystals to glass) difference between flow margin and interior would be also important when we consider thermal contraction. It is also a problem when platy joints form, especially in the case that columnar and platy joints intersect without terminating each other. Occasionally platy joints are filled with tridymite and/or mica mineral with or without andesitic to dacitic melt, which might be segregated from the crystallizing lava body, suggesting that platy joints start to form at early stage of cooling of lava.

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Keywords: platy joints, flood andesite, internal flowage, thermal contraction, segregation vein

SCG61-07 Room:311 Time:May 2 10:30-10:45

Oxidation stats of Fe within constituent minerals in spinel-lherzolite xenolith from Tariat Depression, Mongolia: Signif

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The Tariat depression is one of the most famous areas of deep-seated megacrystic xenoliths and mantle-derived xenoliths in the Baikal-Mongolia rift. Spinel-garnet-bearing websterite, garnet lherzolite and spinel lherzolite have been found in this area (Osanai et al. 2010). In this study, oxidation state of Fe in olivine (Ol), orthopyroxene, clinopyroxene and spinel in fresh spinel-lherzolite xenolith, and olivine in host basalt in Tariat depression were investigated using Mossbauer spectroscopy, X-ray FeL?/FeL?-intensity ratio analysis (EPMA method) and transmission electron microscopy (TEM).

Olivine, clinopyroxene, orthopyroxene and spinel have homogeneous chemical compositions. Olivine is forsterite with average composition of $Fo_{90}Fa_{10}$, Clinopyroxene is Na-bearing diopside [$(Na_{0.17}Ca_{0.71}Mg_{0.81}Fe_{0.09}Al_{0.20})$?2.00$(Si_{1.89}Al_{0.11})$?2.00$O_6$], and have symplektite consisting of diopside and glass on the rim with the width of ˜50 micro m. The chemical composition of the glass is similar to that of feldspar with compositions of An. Orthopyroxene is [$(Mg_{0.85}Fe_{0.09}Al_{0.04}Ca_{0.02})(Si_{0.94}Al_{0.06})O_3$]. Spinel is [$(Mg_{0.81}Fe^{2+}_{0.22})$?1.03$(Al_{1.80}Cr_{0.17})$?1.97$O_4$].

The Fe^{2+}: Fe^{3+} ratios of forsterite, orthopyroxene, clinopyroxene and spinel determined by Mossbauer analysis are 97(1):3(1); 85(8):15(1); 74(4):26(3); 66(8):34(5), respectively. Fe^{3+} in olivine is not attributed to any precipitates nor minute inclusions, which was confirmed by TEM observation, and, thus, exists in olivine structure. Fe of olivine phenocrysts from host basalt lava is only Fe^{2+} which was proved by EPMA method.

Fe^{3+}-bearing forsterite in spinel-lherzolite xenolith is considered to have been stable under mantle condition.

Keywords: olivine, oxidation state of Fe, spinel-lherzolite xenolith, Mossbauer methods, Mongolia

SCG61-08　　　　　　　　Room:311　　　　　　　　Time:May 2 11:00-11:15

Al/Si disordered anorthite in anorthite megacryst from Miyake-jima: effect of non-stoichiometry on Al/Si distribution

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The crystal chemistry of anorthite with the low content of albite (An92.0Ab3.4), part of a rapid cooled, anorthite megacryst occurring in 1940 ejecta from Miyake-jima volcano, Japan, has been investigated using single-crystal X-ray diffractometer and electron microprobe analyzer with wavelength dispersive X-ray spectroscopy (EMPA-WDS). The structure was refined in space group P-1 and cell parameters, a = 8.182(6) Å, b = 12.883(4) Å, c = 7.092(4) Å, α = 93.19(4) ^{0} , β = 115.91 (4) ^{0} , γ = 91.18 (4) ^{0} . The final weighted R-factor is 3.77 % for 1549 reflections. Averaged T-O distances are 1.681 Å for T1(0), 1.674 Å for T1(m), 1.677 Å for T2(0) and 1.680 Å for T2(m), indicating each Al occupancy of 0.501, 0.453, 0.472, and 0.496, respectively. These results suggest that the Al/Si-distribution in the tetrahedral framework is highly disordered (QOD = 0.06), which results in having the c-axis in half along that determined in Al/Si ordered anorthites (c ~14 Å).

Keywords: Anorthite, Al/Si order-disorder, Anorthite megacryst, Structual heterogeneity

Formation temperature of perlite and its texture by heating experiments of obsidians from Hokkaido

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The obsidians from Hokkaido were heated in electric furnaces to transform the perlite in a form like pumice in vitreosity, because remained water in obsidians becomes the gas and makes air bubbles by heating.

We examined foaming temperature of the obsidians from 13 samples in 7 Hokkaido sources, and the relations with its foaming temperature and the water content of the obsidians. In addition, we changed a heating temperature and a condition of the heating time and examined the difference in foaming form of the perlite.

Finally, we considered a relations with foaming process of the obsidians and the internal structure of the perlite through the microscopy of the perlite.

Keywords: obsidian, heating experiment, perlite, vesiculation, glass

SCG61-10　　　　　　　　Room:311　　　　　　　　Time:May 2 11:30-11:45

Estimation of intracrystalline distribution coefficient of Mg-Fe ions in olivine using Cs-corrected STEM

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Intracrystalline distribution coefficient of Mg-Fe ions between the two types of the octahedral sites (M1, M2-site) of olivine, $(Mg,Fe)_2SiO_4$, have been estimated using X-ray or neutron diffraction studies. Recently, the high angle annular dark field (HAADF) method using scanning transmission electron microscopy with the correction of spherical aberration (Cs-corrected STEM) visualizes the element column sites in crystalline samples. In the present study, the intracrystalline distribution coefficient of Mg-Fe ions in olivine were tried to estimate using HAADF-STEM. And furthermore, Crystal Structure Analysis of same sample was carried out using e four-circle X-ray diffractometer. We used the synthetic forsterite and the natural olivine from San Carlos, Sri Lanka and Miyake-jima. HAADF-STEM images parallel to a-axis show the Mg / Fe atom columns and the columns which alternately formed of Si and O atoms. Intracrystalline distribution coefficients estimated from the brightness in M1/M2-sites for synthetic forsterite, the olivines from San Carlos and SriLanka are good agreement with those estimated from X-ray method. On the other hand, that obtained from Miyake-jima is different with that obtained from X-ray method.

Keywords: STEM, olivine, intracrystalline distribution coefficient

SCG61-11　　　　　　　　Room:311　　　　　　　　Time:May 2 11:45-12:00

A Novel Approach for the Classification of Mineral Ore Particles by A Statistical Raman Spectroscopic Method

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[Introduction]

Mineral ores extracted by mining go through a milling process before ore dressing. An important factor in both milling and ore dressing operations is the determination of the particle size distribution of the materials being processed, commonly referred to as particle size analysis. An elemental analysis technique such as X-Ray fluorescence and destructive wet chemical analysis can determine the quantity of mineral species present in the ore, however, these chemical analysis methods do not allow the study of the composition of individual particles of different size and shape. The statistical Raman spectroscopic method is a novel approach which can resolve this problem. Using this method the Raman spectra of several hundred particles is determined after size and shape classification of each individual particle by automated particle image analysis. Raman spectroscopy can be used to acquire the spectra of any inorganic compounds such as metal oxides and nitrides which are Raman active. Many mineral resources are mined as inorganic compounds. Therefore, Raman spectroscopy can be used for the identification of the chemical composition of mineral ores. Using the statistical Raman spectroscopic method described herein, it is possible to calculate the particle size distribution and proportion by mass or volume of each chemical component or mineral species based on Raman spectroscopic information. This study will report and discuss the capability of the statistical Raman spectroscopic method using iron ore as a model material.

[Material and Method]

Iron ore samples were purchased from a vendor. These samples had been through the ore dressing process. Statistical Raman analysis was carried out using a Morphologi G3SE-ID instrument (Malvern Instruments, UK) equipped with a dry powder sample dispersion unit (SDU) and Raman module. The laser wavelength of Raman excitation was 785nm the laser power was less than 5mW and the irradiation time was 5 sec. The particle image measurements were made in diascopic mode with a total magnification 250x. Iron ore dry powder samples were dispersed using the SDU using a short duration pulse of compressed air. Measurements were made automatically using Standard Operating Procedures (SOPs) which define the software and hardware settings used. Measurement sample was dispersed on to glass plate as sample carrier which was minimized environmental exposure by the enclosed sample chamber unit. Particle identification by Raman analysis used the spectrum correlation coefficient approach.

[Results and Discussion]

A Total of 66,436 particles of iron ore were measured by image analysis. The circle equivalent diameter particle size distribution by volume (VCED) exhibited a monomodal distribution with size distribution percentiles as follows: 8.62μm (d10), 21.83μm (d50), 51.29μm (d90). A subset of 700 particles were selected and the Raman spectra were measured. Particles over 20 micron in size were selected randomly from the image analysis data and Raman spectra were acquired. The spectra enabled identification of 4 components (Fig.1). The relative proportion of each component by volume or number of particles is shown in Table 1. Component (A) comprised approximately 90% of the sample. This component exhibited a Raman spectrum typical of α-Fe_2O_3 [1]. It is assumed that components (B) and (C) are polymorphs based on the ratio of the intensities at $221cm^{-1}$ and $245cm^{-1}$. Component (D) exhibited a spectrum typical of α-FeOOH and composed less than 3% of the sample. This result does show that the statistical Raman analysis approach can detect components present at quite low concentrations.

[Summary]

This report illustrated the application and capability of statistical Raman analysis for the characterization of mineral ores using a new approach based on combining chemical and particle size / shape information.

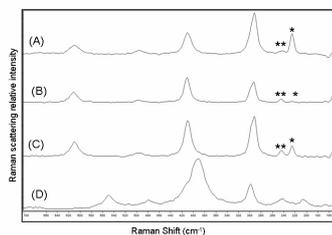SCG61-11   Room:311   Time:May 2 11:45-12:00

Fig 1. Raman Spectrums of iron ore.
(* : 221cm⁻¹, ** : 245cm⁻¹)

Table 1.
Ratio of each component based on Raman spectrum

Component	Number (%)	Volume(%)
A	87.6	90.2
B	2.5	2.1
C	7.2	6.3
D	2.7	1.4

SCG61-12 Room:311 Time:May 2 12:00-12:15

Assessment of Nakhile porphyry Cu mineralization potential using geological, geochemical and statistical studies: a case

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The Nakhile Cu mineralization is located in 145 km northwest of Zahedan in Sistan and Baluchestan province of Iran. This area is geologically located in boundary part of Lut block and flysch zone of east Iran. Geology of the study area consists of Cretaceous to Eocene andesitic lavas and tuffs that were intruded by a dioritic to quartz-dioritic stock. The intrusive rocks are mainly altered and mineralized. Based on the petrography and XRD studies, main mineral in all types of the igneous rocks is plagioclase and the main texture is porphyry. Other minerals are clinopyroxene, amphibole, biotite, quartz, and secondary minerals that vary in the igneous rocks. A large part of the intrusive rocks is rich in pyrite. The pyrite occurs as veins, veinlets and disseminated in the stock. Cu mineralization occurs as vein and can be divided into hypogene and supergene mineralization. Hypogene mineralization is characterized by chalcopyrite and pyrite while supergene mineralization is characterized by malachite, azurite, jarusite, ghothite, hematite and limonite. The propylitic alteration is dominant feature of the intrusive rocks as a wide outer zone. Potassic, phyllic and argillic alterations are also important in the area. The potassic alteration is probably important in the center part of the stock in depth. phyllic and argillic alterations are mainly formed by supergene processes.

The samples that were collected from the least altered and altered rocks in the study area were analyzed by ICP were processed by convenient software such as EXEL and SPSS to obtain statistic parameters of: skewness, maximum, minimum and standard deviation. Then, the histograms for the amount of Cu, Au and related elements were drawn and their correlation coefficients were calculated. There are remarkable positive correlations between Cu, Au and Ag indicating their similar origin. The highest content of Cu is 7000 ppm in the study samples. The Cu anomalies are mainly observed in central and eastern parts of the area. The highest content of Au is 6000 ppb. The Au anomalies are mainly observed in western parts of the area. The higher contents of Pb, Zn and Ag are observed more away from the intrusive rocks.

The outcrops in the area are mainly similar as propylitic alteration zone of porphyry Cu deposits that is characterized by secondary hydrothermal epidote and chlorite and pyrite. The Cu porphyry mineralization and other alteration zones specially potassic probably occur in depth in the area.