location, lithology, nature of contacts, grain size, bedding characteristics, diagenetic features, stratigraphic nomenclature, rock correlation, and a variety of biostratigraphic data. These data are then overlain with interpretive data, such as lithofacies and biofacies maps, position of sequence boundaries, and assignment to a lithotectonic terrane. Graphical displays of the measured sections are linked to underlying digital data tables that include descriptive and interpretive information on lithology, stratigraphy, and biofacies. Once in digital form, these stratigraphic data can be organized and displayed along with other relevant data sets in space and time for the purposes of paleogeographic reconstruction, investigations of regional metallogeny, and the development of facies interpretations that may be generally tied to variations in porosity and permeability and have utility for evaluation of potential ground-water flow paths. As most syngenetic mineral deposits are related to sedimentary facies and depositional environment, time-slice paleographic maps generated from the measured sections can be used in exploration for mineral deposits.

166-3 BTH 175 Diehl, Sharon F.

PALEOZOIC TECTONICS, BRINE MIGRATION, AND FORMATION OF HYDROTHERMAL ZEBRA DOLOMITE, SEDEX AND MVT DEPOSITS ALONG THE CARBONATE PLATFORM IN THE GREAT BASIN

DIEHL, Sharon F.[1], HOFSTRA, Albert H.[2], KOENIG, Alan E.[3], LUFKIN, John L.[4], EMSBO, Poul[2], and VIKRE, Peter[5], (1) U.S. Geol Survey, Box 25046 DFC, M.S. 964, Denver, CO 80225-0046, diehl@usgs.gov, (2) U.S. Geological Survey, Denver, CO 80225, (3) U.S. Geological Survey, Box 25046, Denver Federal Center, Denver, 80225, (4) University of Colorado, Campus Box 172, PO Box 173364, Denver, 80201, (5) U.S. Geol Survey, Mackay School of Mines, MS 176, University of Nevada, Reno, Reno, NV 89557-0047

Hydrothermal zebra dolomite is typically composed of alternating horizontal layers (approx. 1-10 mm) of dark, fine-grained dolomite and white, coarse-grained, sparry, void-filling dolomite. Worldwide, zebra dolomite is associated with oil fields, Mississippi Valley-type (MVT) Pb-Zn deposits, and Sedex Pb-Zn±Ba±Au deposits that are produced by movement of hot basinal brines through permeable strata and faults. Hence, its distribution marks brine-migration pathways.

Zebra dolomite localities extend from Death Valley, California, across Nevada, and into western Utah. In the Great Basin, zebra dolomite primarily occurs in the platform-margin to inner-shelf facies of Cambrian, Devonian, and Mississippian strata. It is genetically associated with Devonian Sedex Au, Zn, and barite in the Carlin trend (e.g., Meikle) and MVT Pb-Zn-Ag mineralization in the Goodsprings district and Death Valley region. Elsewhere, it served as a host rock for Cretaceous pluton-related polymetallic replacement deposits (e.g., Ruby Hill) and late Eocene Carlin-type gold deposits (e.g., Windfall, Meikle). Zebra dolomite is associated with high-angle fractures and faults that constitute flower structures and with dissolution processes that led to solution collapse and brecciation. Because of the resulting high-permeability textures and high Fe content, zebra dolomite was an ideal host for younger polymetallic replacement and Carlin-type gold deposits. Therefore, an improved understanding of the age, distribution, and chemical and isotopic signatures of zebra dolomite is relevant to development of genetic and exploration models for base and precious metal deposits in the Great Basin.

Field relationships and the regional distribution of hydrothermal zebra dolomite localities suggest that most formed in response to two (or more) Paleozoic tectonic events. Some zebra dolomites were produced during Devonian extension (e.g., Meikle), whereas others appear to have formed during Mississippian or younger contractional orogenesis (e.g., Goodsprings). Both types of tectonism likely stimulated movement of metal-bearing basinal brines.

166-4 BTH 176 Crafford, A. Elizabeth Jones

NEW DIGITAL CONODONT COLOR ALTERATION INDEX (CAI) MAPS OF NEVADA

CRAFFORD, A. Elizabeth Jones, GeoLogic Services, 9501 Nettleton Drive, Anchorage, AK 99507, ecrafford@alaska.com and HARRIS, Anita G., U.S. Geological Survey, emeritus, 1523 E Hillsboro Blvd #1031, Deerfield Beach, FL 33441-4307

Conodont color alteration indices (CAI) from 2,617 conodont collections from Nevada were used to provide constraints on the geologic history of Paleozoic and Triassic rocks throughout the state and to help identify post-Triassic heat-flow patterns that affected these rocks. While Tertiary volcanism and Mesozoic plutonism have had important local affects on CAI values of conodonts from Upper Cambrian through Triassic rocks, many of the values also record older events relating to the stratigraphic and tectonic history of the pre-Jurassic rocks. The CAI values help to define tectonic domains, regions of accreted terranes, areas of hydrothermal alteration or mineralization, and other structural and stratigraphic complexities throughout the state.

CAI values in Mississippian through Triassic rocks in southern and eastern Nevada are uniformly low with a few notable exceptions likely due to high heat flow from nearby igneous or hydrothermal sources. In western, northern, and far northeastern Nevada, Mississippian through Triassic rocks are within highly tectonized accreted terranes and generally have high or very high CAI values (4.0-8.0).

Deeper stratigraphic burial of Devonian through Ordovician rocks in southern Nevada produced moderate CAI values (3.0-4.0) that agree with field observations of stratigraphic thickness and apparently average geothermal gradient. In the east-central part of Nevada the lower Paleozoic stratigraphic section was not thick enough to alter the conodont color. Very high CAI values (5.0-8.0) occur in Cambrian and Ordovician rocks in a north-south belt in the center of the state. These rocks bear evidence of a tectonic history of burial, deformation and movement that is not reflected in coeval rocks to the east. This additional tectonism is interpreted as the source of the unusually high CAI values in these rocks.

Notable places where mineralizing systems have likely affected the CAI value include the Independence Mountains, the Tuscarora Mountains, the Fish Creek Range, and the Bullfrog Hills. A number of examples of anomalously high CAI values from tectonic loading and other high heat flow sources can also be identified.

Correlations of conodont CAI values with geologic and geophysical data are another valuable tool for interpreting the complex geology and earth resources of Nevada.

166-5 BTH 177 Sweetkind, Donald

TECTONIC RECONSTRUCTIONS BASED ON REGIONAL CROSS SECTIONS TO INCREASE UNDERSTANDING OF METALLOGENY AND FLUID FLOW IN THE NORTHERN GREAT BASIN

SWEETKIND, Donald, U. S. Geol Survey, Denver Federal Center, Box 25046, Lakewood, CO 80225, dsweetkind@usgs.gov, WALLACE, Alan, University of Nevada, U.S. Geological Survey, Reno, NV 89557-0047, NUTT, C.J., Mineral Resources Team, U.S. Geological Survey, Box 25046, M.S. 973, Denver, CO 80225, JOHN, David A., U.S. Geological Survey, 345 Middlefield Rd, MS-901, Menlo Park, CA 94025, HOWARD, Keith, GEO-WRG-NGM, US Geol Survey, Menlo Park, CA 94025, PERSON, Mark Austin, Geological Sciences, Indiana University, 1001 E 10th St, Bloomington, IN 47405, PONCE, David A., U.S. Geological Survey, 345 Middlefield Rd, Menlo Park, CA 94025, GLEN, Jonathan M.G., U.S. Geol Survey, MS989, 345 Middlefield Road, Menlo Park, CA 94025, and EVANS, James, U.S. Geol Survey, 904 W. Riverside, Spokane, WA 99201

A complex series of regional to local geologic events, beginning in the Archean and continuing to the present, have resulted in the formation of the world-class mineral endowment in the northern Great Basin. Understanding the links between regional tectonic and metallogenic events necessitates the construction of the geologic framework in 2- and 3-dimensions. To this end, a series of regional cross sections have been constructed across the northern Great Basin to help understand the geologic events that led up to, were synchronous with, and followed major periods of mineralization. These sections extend to depths of at least 5 km in order to portray crustal structures that may have localized multiple episodes of deformation, magmatism, regional fluid flow, and hydrothermal activity. The top of pre-Cenozoic rocks in the cross sections is based on inversion of gravity data. Regional stratigraphic trends and aeromagnetic, magnetotelluric, geochronologic, geobarometric, and conodont CAI data constrain the deeper parts of the sections. One of the purposes of creating the cross sections, which portray the present-day three-dimensional geometry, is to remove the effects of younger events, allowing reconstruction of the geologic setting through time. For instance, to understand the structural and stratigraphic setting during the metallogenically important late Eocene, the effects of late Cenozoic extensional deformation are removed by restoring fault offset, as constrained in part by the distribution, thickness, and provenance of Neogene and Paleogene sedimentary and volcanic rocks. The effects of Late Paleozoic to Early Tertiary contractile deformation are removed by understanding the age and distribution of lithotectonic terranes and through the reconstruction of Paleozoic facies trends. The resulting geologic models show the regional controls on and locations of deformation, sedimentation, magmatism, and hydrothermal activity and frame numerical models of fluid flow, and mass transport during each event. Thus far, geologic sections for the present, mid-Miocene, and late Eocene have been coupled with fluid flow models that are calibrated to temperature, stable isotopes, and silica saturation to improve understanding of active geothermal systems, low sulfidation Au-Ag, and Carlin-type Au deposits.

166-6 BTH 178 du Bray, Edward A.

A NEW WHOLE-ROCK MAJOR-OXIDE AND TRACE-ELEMENT GEOCHEMICAL DATABASE FOR INTRUSIVE ROCKS OF NORTHERN NEVADA: IMPLICATIONS FOR PETROGENESIS AND METALLOGENY

DU BRAY, Edward A. and NASH, J. Thomas, U.S. Geological Survey-MS 973, Box 25046, DFC, Lakewood, CO 80225, edubray@usgs.gov

Earth scientists working in northern Nevada have long recognized that regional to local intrusive activity has played a critical role in the geologic evolution of the region and has been key to the genesis of many ore deposits located therein. Although these rocks have been the focus of much research, most studies have focused on limited numbers of intrusive centers. Compilation and interpretation of whole-rock major-oxide, trace-element, mineralogic, and geochronologic data are essential to an understanding of regional magmatism and how various magmatic episodes contribute to the genesis of numerous, large ore deposits, particularly gold deposits.

Previous work in northern Nevada has documented major magmatic pulses in the Jurassic, Cretaceous, and middle Tertiary. By establishing compositional characteristics of intrusive rocks associated with these time increments, particularly their relative trace-element abundances, the tectonic setting in which associated magmas were generated can be inferred. For example, region-scale genetic links and postulated continuity between magmatism represented by the Sierra Nevada and Idaho batholiths are ambiguous. Northern Nevada bridges these two classically arc-related magmatic systems. Consequently, defining the tectonic setting of northern Nevada intrusive rocks using trace element abundances may help determine whether arc magmatism was spatially and temporally continuous across this region. Similarly, the intrusive rock geochemical database may define empirical geochemical associations between some intrusive centers and ore deposits, thereby helping focus the search for ore deposits through refinement of exploration methodologies. A specific goal related to compilation and synthesis of this database is to determine whether descriptive geochemical indices can be developed to identify intrusive centers that are associated with ore deposits, particularly gold deposits. Defining geochemical indices that identify barren plutons is equally important. The northern Nevada intrusive rock geochemical database is a work in progress. Ultimately, data contained therein can be used to characterize the geochemical attributes of northern Nevada intrusive rocks and interpret their petrogenetic evolution and metallogenic associations.

166-7 BTH 179 John, David A.

MULTIPLE UNITS OF THE CAETANO TUFF, NORTHERN NEVADA: CALDERA SOURCE AND PRELIMINARY GEOCHRONOLOGY AND GEOCHEMISTRY

JOHN, David A., U.S. Geological Survey, 345 Middlefield Rd, MS-901, Menlo Park, CA 94025, djohn@usgs.gov and HENRY, Christopher D., Nevada Bureau of Mines and Geology, University of Nevada, MS 178, Reno, NV 89557

The Caetano Tuff (CT), a widespread late Eocene ash-flow tuff in northern Nevada, was interpreted to be a single unit that erupted from and accumulated in a 20 x >100 km east-west volcano-tectonic trough (Burke & McKee, 1979), although almost all Great Basin ash-flow tuffs are associated with calderas. The CT is petrographically distinctive with abundant smoky quartz and sanidine, and our new field work, $^{40}Ar/^{39}Ar$ dates, and chemical analyses (including published data) demonstrate at least two compositionally and temporally distinct eruptive units. The younger tuff erupted from and accumulated in a 17 (N-S) x <40 km (E-W, present day, including later extension) caldera that coincides with only the eastern part of the trough, whereas much of the classic outflow CT is older and not clearly associated with the caldera. The caldera extends west from the Toiyabe Range to the Shoshone Range but does not continue into the Fish Creek Mtns. The entire caldera boundary is a steep fault against Paleozoic rocks. An approx. 40°, E-tilted section in the Toiyabe Range is at least 2.7 km thick and contains abundant mega- and mesobreccia of Paleozoic sedimentary and Cenozoic volcanic rocks. Intracaldera sections in the Shoshone Range are >700 m thick. This younger CT is mostly high-SiO_2 rhyolite with 74-77% SiO_2. Seven preliminary sanidine, $^{40}Ar/^{39}Ar$ dates on intracaldera and outflow tuff and an intracaldera intrusion range from 33.50±0.07 to 33.72±0.08 Ma. The older CT, whose correlation is based primarily on megascopic composition, forms extensive outflow in the northern Shoshone Range, Battle Mtn, Fish Creek Mtns, and Tobin Range. It is nowhere more than 200 m thick, and the base is generally exposed. The older tuff is low-SiO_2 (71-73%) rhyolite. Two $^{40}Ar/^{39}Ar$ dates on

AM

TUESDAY

tuffs in the northern Shoshone Range done at different labs are 34.23±0.04 and 34.45±0.08 Ma. This older tuff could be an early eruption from the caldera that produced the younger tuff or from an unrelated, unknown source. A caldera proposed at Mt. Lewis in the northern Shoshone Range (Wrucke & Silberman, 1975) cannot be the source of any CT because their "Caetano intrusions" are ~39 Ma (Kelson et al., 2005). The correlation of other proposed CT exposures in the region remains uncertain because correlation is based only on petrographic characteristics.

166-8 **BTH 180** Hudson, Donald M.

GEOLOGIC SETTING, GEOCHEMISTRY, AND GEOCHRONOLOGY OF EPITHERMAL GOLD-SILVER DEPOSITS IN THE SEVEN TROUGHS DISTRICT, NORTHWEST NEVADA

HUDSON, Donald M., 1540 Van Petten St, Reno, NV 89503, dmhudson@intergate.com, JOHN, David A., U.S. Geological Survey, 345 Middlefield Rd, MS-901, Menlo Park, CA 94025, and FLECK, Robert J., U.S. Geological Survey, 345 Middlefield Road, Menlo Park, CA 94025

The Seven Troughs district, near Lovelock, NV, contains small, high-grade low-sulfidation epithermal Au–Ag vein deposits temporally and spatially related to a bimodal suite of middle Miocene volcanic rocks. The district produced about 158,468 oz Au and 995,876 oz Ag from 152,339 tons of ore in the early 20th century. Ore consisted of quartz-adularia veins containing coarse electrum, naumanite, and minor base metal sulfide minerals. Volcanic host rocks form a rhyolite flow-dome complex, intercalated with volcaniclastic sedimentary rocks and basalt to andesite lava flows and dikes, that overlies and intrudes older tuffs and Mesozoic basement. Despite an overall bimodal composition (49–61 and 71–77 wt. % SiO_2), the volcanic rocks have characteristics of both calc-alkaline and tholeiitic suites. Notably, mafic rocks are compositionally similar to tholeiitic basalts related to the northern Nevada rift, whereas many rhyolites have more calc-alkaline compositions and contain biotite and/or hornblende phenocrysts. The volcanic rocks were emplaced into a narrow (~2.5 km wide) NNE–trending graben formed during syn-magmatic extensional faulting. Veins are controlled primarily by N– to NNE–striking normal faults, many of which also are intruded by basalt dikes. Biotite and sanidine $^{40}Ar/^{39}Ar$ dates (FCT=28.02 Ma) on pre- and post-mineral rhyolites range from 14.41±0.09 to 13.78±0.06 Ma (5 samples), a basalt dike is 14.1±0.2 Ma, and adularia from the Mazuma vein is 13.82±0.02 Ma. The coeval volcanic rocks and low-sulfidation deposits at Seven Troughs are distinctly younger than most similar epithermal deposits in the northern Great Basin (NGB) (mostly 16.5 to 15 Ma; e.g., Midas, Sleeper, Buckskin-National, Hog Ranch, Ivanhoe). In addition, Seven Troughs lies along one of the magnetic anomalies suggested to have formed by rifting and mafic magmatism related to the Yellowstone hot spot at about 16.6 Ma (Glen and Ponce, 2002, Geology); our dates suggest that faulting and magmatism at Seven Troughs is about 2 m.y. younger than the age inferred for this feature. Compositional and age differences between Seven Troughs and other middle Miocene rhyolite-hosted epithermal deposits suggest that the Seven Trough deposits may be more closely related to Western Cascades calc-alkaline magma than other rhyolite-hosted deposits in NGB.

166-9 **BTH 181** Tilden, Janet E.

THREE-DIMENSIONAL GEOLOGIC MODEL OF THE BEOWAWE GEOTHERMAL AREA, NORTH-CENTRAL NEVADA

TILDEN, Janet E.[1], PONCE, David A.[1], GLEN, Jonathan M.G.[1], JOHN, David A.[1], and PERSON, Mark A.[2], (1) U.S. Geological Survey, 345 Middlefield Rd, Menlo Park, CA 94025, jtilden@usgs.gov, (2) Geological Sciences, Indiana Univ, 1001 E. 10th St, Bloomington, IN 47405

A simplified three-dimensional geologic model of the Beowawe geothermal area, including parts of Battle Mountain, Shoshone Mountains, and the Sheep Creek Range, was developed from geologic, geophysical, and drill-hole information to aid fluid flow modeling and provide a framework for tectonic interpretations of northern Nevada. The model encompasses a volume about 85-km long, 75-km wide, and 6-km deep, approximately centered on the Beowawe geothermal area in north-central Nevada. Five stratigraphic layers were defined: low-density basin-filling deposits, volcanic rocks, basalt-andesite rocks of the northern Nevada rift (NNR), and Paleozoic sedimentary rocks of the upper and lower plate of the Roberts Mountain allochthon.

The model is based on surface geology, geologic cross sections, drill-hole information, and 2D geophysical models. Using an iterative gravity inversion technique, geophysical data were particularly useful in determining the thickness of low-density basin-filling deposits. Geologic cross sections were constrained using two-dimensional geophysical (gravity and magnetic) modeling techniques. Geologic layers were extrapolated across the area of the model from the revised geologic and geophysical cross sections and imported into a geologic modeling and visualization software package that allows fully three-dimensional rendering and manipulation (EarthVision, Dynamic Graphics, Inc., Alameda, Calif.).

The Beowawe geothermal system lies within a 1.5-km thick basin, about 10 km east of the magnetically-defined northern Nevada rift, along a zone of prominent ENE-striking faults (e.g., Malpais fault) that bound the southern edge of Whirlwind Valley, and near prominent N-striking faults (Dunphy Pass fault zone). Due to the increased permeability along these faults, the faults are likely conduits for groundwater flow from the Humboldt River to Beowawe. In addition, major NNW-striking structures bounding the Shoshone Range (e.g. Muleshoe Fault) may provide another source for groundwater recharge.

166-10 **BTH 182** Granitto, Matthew

GEOCHEMICAL DATA FOR THE GREAT BASIN: A SUBSET OF THE USGS NEW NATIONAL GEOCHEMICAL DATABASE

GRANITTO, Matthew, YAGER, Douglas, and HOFSTRA, Albert H., USGS, Denver, CO 80225, granitto@usgs.gov

Several legacy U.S. Geological Survey (USGS) hard copy and digital geochemical databases used between 1962 and 2002 have been digitally compiled and merged into the National Geochemical Database (NGDB). We have culled analytical data from the NGDB to create a subset for the Great Basin. The initial goal is to verify and publish these data so that they can be accessed and used by earth scientists. Displays of stream sediment or soil and rock data are being used to evaluate the geochemical expression of rock units, mineral belts, and significant ore deposits at various scales.

The Great Basin dataset contains analyses of rocks (94,380), stream sediments and soils (114,980), heavy mineral concentrate fractions of these sediments and soils, minerals (8,030), waters (3,080), organic materials (3,000), and leachates (260). Analytical records were derived from 4 principle sources. The first represents 730,000 records that were formerly in the USGS Rock Analysis Storage System (RASS), which was primarily used during regional mineral resource investigations between the 1960's and 1980's in support of resource assessment programs. The second, comprised of an additional 530,000 records collected during topical studies between the 1960's and 1995, were part of the "Pluto" database. The third is comprised of records generated since 1995. The fourth is an additional 195,000 analytical records that may be added but were never entered into either RASS or Pluto.

Re-processing of the Great Basin dataset was initiated in 2004 to correct errors in sample locations, add missing sample locations, and identify the sample media and analytical protocol of each record. This was done using original sample submittal forms, publications, field notebooks and base maps, and discussions with submitters and analysts. Fields were added to the original data to more fully describe the sample preparation methods used and sample media analyzed.

SESSION NO. 167, 1:30 PM

Tuesday, October 18, 2005

Geochemistry

Salt Palace Convention Center, 251 AB

167-1 **1:30 PM** Otahal, Joan Marie

ELEMENT MOBILITY IN THE CHEMICAL EVOLUTION OF A GEOTHERMAL SYSTEM, HUMBOLDT HOUSE GEOTHERMAL AREA, PERSHING COUNTY, NEVADA

OTAHAL, Joan Marie, Graduate Program for Hydrologic Sciences, University of Nevada, Reno, MS 175, Reno, NV 89557, jotahal@unr.edu, JOHNSON, Jennifer Lyn, Graduate Program for Hydrologic Sciences, Univ of Nevada, Reno, MS 175, Reno, NV 89557, and TEMPEL, Regina N., Dept. of Geological Sciences and Engineering, University of Nevada, Reno, MS 172, Reno, NV 89557

Humboldt House geothermal area (HHGA), located in Pershing County Nevada, is characterized by upwelling of hot geothermal fluids along high-angle, range bounding faults and lateral dispersal into adjacent lacustrine basin sediments. Core was recovered from three geothermal wells during a 2003 drilling program to evaluate the chemical evolution of geothermal fluids. Approximately 1800 feet of core was recovered from wells P32-2, P10-1 and P3-1. The P32-2 core rocks are slightly altered pluvial/fluvial sediments. Both P10-1 and P3-1 are composed primarily of highly altered silicified conglomerates.

Chemical evidence from major and trace element distributions suggests several episodes of silica-rich fluids that leached major and trace elements from the host rock during alteration and deposited secondary mineral phases rich in base and precious metals. The general geochemical trend in both the major and trace element distribution in the cores shows a decrease in the concentration of the major and trace element as the silica concentration increases. These changes are especially evident in the trace element distribution between unaltered conglomerates and the highly altered silicified conglomerates in the P10-1 core. For example, concentrations of rare earth elements (REE) in silicified zones decrease significantly in comparison to the REE concentration in the unsilicified zone. Specifically, the concentration of Ce decreases from an average of 75 ppm in the unsilicified zone to an average of 21 ppm in the silicified zone and Nd decreases from an average of 33 ppm to 10 ppm. The concentrations of Fe, Al, Na and K also decrease considerably in the silicified zone. Concentrations of Au, Ag, Mo and As increase notably along with Si concentrations in highly-altered zones. Disseminated pyrite and a decrease in the positive Eu anomaly indicate that the silica-rich fluids were likely reducing.

167-2 **1:45 PM** Delattre, Simon Luc

RADIATION-DAMAGE ENHANCED CHEMICAL ALTERATION OF ZIRCON IN LATERITE, NSIMI, CAMEROON

DELATTRE, Simon Luc, TAO, Ecole Normale Superieure, 24 rue Lhomond, Paris, 75005, France, simon.delattre@ens.fr, UTSUNOMIYA, Satoshi, Department of Geological Sciences, Univ of Michigan, 425 East University Ave, Ann Arbor, MI 48109-1063, EWING, Rodney C., Geological Sciences, University of Michigan, 2534 C.C little Building, 1100 N. University Avenue, Ann Arbor, MI 48109-1005, and BALAN, Etienne, LMCP, University Paris VI and VII, 4 place Jussieu, Paris, 75252, France

Zircon, as a nearly inert mineral, does not undergo chemical loss during soil formation and has been used for mass balance calculations; however, radiation damage from the alpha-decay of U and Th increases its chemical reactivity during the formation of laterite, especially in the upper organic rich zone of the profile. The relation between zircon alteration and accumulated radiation damage in a laterite was examined in three sets of samples that formed by direct alteration of the bedrock, the homogeneous soil and the organic rich horizon. Secondary electron (SE) and back-scattered electron (BSE) images of the zircons clearly revealed evidence of alteration within regions that were highly radiation damaged. The chemical compositions of zircons have a trace amount of impurity elements; Al and Fe (up to 1 wt. %). The correlation of alpha-decay dose (0.1 to 1.5 displacements per atom) and the increased concentrations of Al and Fe indicates that the extent of alteration is controlled by the extent of remnant crystallinity. EMPA of zircons near the source rock, gave discordant chemical ages (0.2-1.9 By), but the actual age (2.7 By) was preserved in several zircons. Based on TEM analysis, there is no evidence of a reprecipitation of baddeleyite (ZrO2) or incongruent dissolution of zircon. The slight Zr-enrichment inferred by electron microprobe analysis of the altered zones (~ 8 wt. %) is probably due to selective leaching of the silica-rich nanodomains over zirconium-rich nanodomains, which exist due to alpha-decay event damage. TEM observation reveals two different micro-textures at the scale of a few tenths of microns. In zircon with randomly oriented crystallites, fractures contain alteration products, i.e. Fe, Al, and Si. In pristine zircon, nano-vesicles are abundant; the vesicles do not form as a connected network and contain some chlorine (more than 5 wt. %) and to a lesser extent, Na and Ca. Moreover, Electron energy loss spectra do not indicate the presence of He, excluding the possibility that those vesicles are the result of accumulation of alpha-particles. The recovery of the crystalline structure may account for the formation of voids because the amorphous domains that are susceptible to recrystallization have a lower density. Amorphous domains probably facilitate elemental diffusion, such as non-magmatic Cl.

167-3 **2:00 PM** Kettler, Richard M.

ASSOCIATION QUOTIENTS OF ALUMINUM OXALATE COMPLEXES IN AQUEOUS SOLUTIONS

KETTLER, Richard M., Department of Geosciences, Univ of Nebraska-Lincoln, Lincoln, NE 68588-0340, rkettler1@unl.edu, PALMER, Donald A., Chemical Sciences Division, Oak Ridge National Laboratory, Oak Ridge, TN 37831-6110, and WESOLOWSKI, David J., Chemical Sciences Division, Oak Ridge Ntional Laboratory, Oak Ridge, TN 37831-6110

Although a number of measurements of the association quotients of Al-oxalate species have been made at 25°C, relatively few measurements exist at higher and lower temperatures. To assess the significance of Al-oxalate speciation in geological systems we have measured equilibria of the form

$$Al^{3+} + nC_2O_4^{2-} = Al(C_2O_4)_n^{3-2n} \quad n \leq 3$$

Formation constants were measured by potentiometric titration using a hydrogen electrode concentration cell. Measurements were made at 8 temperatures ranging from 5 to 150°C and at ionic strengths ranging from 0.1 mol-kg^{-1} to 1.0 mol-kg^{-1} in aqueous NaCl media. When I=0.6 mol-kg^{-1}, the values of Q_1, Q_2, and Q_3 increase from $10^{5.33}$, $10^{9.87}$, and $10^{14.12}$, respectively, at 5°C to $10^{7.41}$, $10^{12.76}$, and $10^{16.04}$, respectively, at 125°C. Values of Q_1, Q_2, and Q_3 at 25°C and I=0.6 mol-kg^{-1} are in good agreement with those published previously after recalculation using more recent values of the dissociation of oxalic acid.