

the Great Basin, Gans and others (GSA Spec. Pap. 233, 1989) reported about 2500% WNW-ESE extension toward the close of and following (until about 20 Ma) an episode of volcanism chiefly 37-34 Ma in east-central Nevada; they also cited work of Proffett (GSA Bull., 1977) near Yerington in central western Nevada where >100% E-W extension occurred after 19 Ma mostly following voluminous volcanism 28-17 Ma.

To evaluate the timing of regional tectonic extension and volcanism elsewhere in the Great Basin, 30 stratigraphic sections of Tertiary rocks have been examined in the southeastern Great Basin. Sections (a) lie outside sources of large volume ash flows so stratal tilts and intercalated deposits of erosional debris cannot be confused with local caldera collapse and resurgence, (b) consist dominantly of well-dated ash-flow sheets that in many sections represent >10 million years of time, and (c) depict the time interval from about 34-17 Ma when the largest volume of magma in the province was erupted, corresponding to the well-known "ignimbrite flareup."

Widespread conglomeratic deposits at the base of the Tertiary sections and intercalated between tuff sheets older than 31 Ma together with local angular unconformities are compatible with an episode of early Oligocene extension as independently documented by Gans and others and by several other geologists in widely scattered places.

After about 31 Ma during peak volcanism epiclastic material appears between tuff sheets in only 6 sections and has an aggregate maximum thickness of 185m, compared to an aggregate maximum thickness of tuff and local lava in the 30 sections of about 20km. Angular discordances appear in only 3 sections. These features, together with widespread conformability of volcanic units that dip gently (generally <30°) indicate only limited and local deformation accompanied peak volcanism; an active rifting model is invalid.

Major extension since the middle to late Miocene has tilted volcanic sections.

No 27762

VARNISH CATION-RATIO DATES - HOW PRECISE CAN THEY BE?

BIERMAN, Paul R. and GILLESPIE, Alan, Department of Geology AJ-20, University of Washington, Seattle, WA 98195

We have conducted numerous chemical analyses of rock varnish and conclude that the precision of measured cation ratios (CRs) and associated age estimates are limited by counting statistics and beam/varnish interactions integral to XRF based analytical systems. Our investigation does not consider additional uncertainty generated by complex patterns of substrate weathering, varnish heterogeneity, and sampling bias.

We calculated the uncertainty of a cation ratio using standard error propagation formulas:

$$\sigma_{CR} = CR [ (\sigma_{Ca}^2 + \sigma_K^2)(Ca+K)^{-2} + \sigma_{Ti}^2 Ti^{-2} ]^{1/2}; CR = (Ca+K) Ti^{-1}$$

PIXE analyses performed on varnish at UC Davis have 1/2 uncertainties of about 6% for Ca and K and 8% for Ti (Gill, pers. comm.). Using a JOEL superprobe equipped with an energy dispersive analyzer, a 1000s counting time, and a beam rastered over an area of >5mm<sup>2</sup>, we measured Ca and K to a 1/2 precision of better than +/-2% and Ti to a precision of +/-5%. Using wavelength analyzers, a maximum count time of 200s/element, and a 0.5 to 50µm spot size, 1/2 precision improved to about 1% for K and Ca and about 3.5% for Ti. The following table gives single sample CR and age uncertainties based on the above-stated precisions, an average Holocene varnish chemistry, and the calibrated logarithmic age equation from Dorn (1987). Elemental concentrations and uncertainties are in units of wt%; ages are in years.

	Ca	1/2	K	1/2	Ti	1/2	CR	1/2	Age	+	-
PXE	1.5	0.090	1.5	0.090	0.5	0.040	6	0.543	5850	2830	5490
EDS	1.5	0.030	1.5	0.030	0.5	0.025	6	0.312	5850	1850	2700
WDS	1.5	0.015	1.5	0.015	0.5	0.018	6	0.214	5850	1340	1740

For samples of 130ka varnishes analyzed by PIXE, 1/2 analytic uncertainties correspond to age uncertainties of about +60/-40ka. Age uncertainty is reduced by analyzing replicates; nevertheless, intrinsic analytic uncertainties, cost of replicate analyses, and the logarithmic nature of the calibration curve limit the precision and usefulness of cation ratio dates.

In addition to analytic uncertainties, when using a 0.5µm electron beam we found that apparent K concentration decreased by over 25% during total analysis times as short as 300s. This indicates that the order in which analyses are performed during a wavelength scan will significantly affect calculated K concentrations and resulting cation-ratios.

No 25045

KR-SR ISOCHRONS USING PARTIAL MINERAL SEPARATES: COMPARISON TO K-AR DATES FROM THE MOGOLLON-DATIL VOLCANIC FIELD.

BIERMAN, Michael, Department of Geology and Planetary Science, University of Pittsburgh, Pittsburgh, PA 15260

Conventional Rb-Sr whole-rock isochrons are based on collecting multiple samples from the unit to be dated and choosing each sample to best vary the Rb/Sr ratio. This study explored the possibility of using large (20 Kg-) samples collected for K-Ar dating as combined multiple samples and using the magnetic and density variations utilized in mineral separation as the divisions among individual samples. Samples from two ash flow tuffs were selected: The tuff of Horse Springs (Ths) gave conventional K-Ar dates of 32.2 m.y. on 80-100 mesh biotite and 36.2 on 40-60 mesh biotite and a Rb-Sr isochron date of 35.3 +/- 1.6 m.y.. Initial Sr ratio of 0.70976 and MSWD of 2.4. The widespread Bloodgood Canyon Tuff (Tbc) with conventional K-Ar dates averaging 28.8 m.y. on biotite, 27.3 m.y. on sanidine and a high-precision <sup>40</sup>Ar/<sup>39</sup>Ar date of 28.0 m.y. on sanidine (McIntosh, 1989, NMB NMR 46, p.58) had an isochron date of 26.7 +/- 0.9 m.y. (0.71008, MSWD = 0.99)

An additional determination on the flow-banded Jerky Mountain rhyolite, which has a K-Ar date of 27 m.y. on sanidine yielded a Rb-Sr isochron date of 28.9 +/- 1.3 m.y. (0.70962 +/- 0.0006, MSWD = 2.8). Sanidines fused in vacuum for conventional K-Ar dates may be incompletely degassed, hence the Rb-Sr date on this rhyolite may be its emplacement date.

The results of this study on the ashflows shows a variety of comparisons: the Rb-Sr isochron date is higher than the fine-grained biotite K-Ar date on Ths; equivalent within error to K-Ar dates on coarse biotite from Ths and sanidine from Tbc; lower than K-Ar dates on biotite and <sup>40</sup>Ar/<sup>39</sup>Ar dates on sanidine from Tbc.

For Cenozoic felsic rocks the Rb-Sr isochron based on partial mineral separates is a useful additional technique.

THE PELONA FAULT, CENTRAL TRANSVERSE RANGES, SOUTHERN CALIFORNIA: AN EXTENSIONAL DETACHMENT FAULT?

BISHOP, Kim M., Dept. of Geological Sciences, University of Southern California, Los Angeles, CA, 90089, EHLIG, Perry L., Department of Geology, California State University, Los Angeles, Los Angeles, CA, 90032.

The Pelona fault is part of a network of faults that affect the late Oligocene to early Miocene terrestrial Vasquez Formation and pre-Cenozoic granitic and gneissic rocks to the south of Sierra Pelona anticline but do not extend into the Pelona Schist in the anticline. Pelona fault has a mapped length of 15 km. Along its eastern third, it places the basal part of the Vasquez Formation against mylonite that overlies Pelona Schist. Further west, a 10 km long fault-bounded wedge of granitic rock separates the Vasquez Formation from Pelona Schist. The Pelona fault dips sub-parallel to foliation in the Pelona Schist. The middle Miocene Mint Canyon Formation unconformably overlies the west end of Pelona fault and adjacent rock indicating fault movement ceased by middle Miocene. Because of its geometry and the absence of Pelona Schist clasts in the Vasquez Formation, we interpret Pelona fault to have been a low angle detachment fault in the time between 15 and 25 Ma, prior to uplift of Sierra Pelona anticline. San Francisquito fault may be a continuation of Pelona fault on the north flank of Sierra Pelona anticline.

No 16886

CONSTRAINTS ON TIMING OF METAMORPHISM, DEFORMATION, AND PLUTONISM IN THE HUCKLEBERRY MOUNTAIN AREA, NORTH CASCADES, WA.

BITTENBENDER, Peter, and WALKER, Nicholas, Department of Geological Sciences, University of Texas, Austin, Texas 78713

The Huckleberry Mountain area of the west-central crystalline core of the North Cascades includes the regionally metamorphosed, epidote-amphibolite to amphibolite grade, predominantly pelitic Chiwaukum Schist (CS) which is intruded by the quartz-dioritic Chaval Pluton (CP). Field, petrographic and U/Pb zircon geochronological evidence demonstrate emplacement of the CP and related dikes post-dated development of metamorphic fabrics in the host CS.

Regional metamorphic foliation in the CS trends NW and is steeply dipping. Mineral and crenulation lineations and small-scale fold axes trend dominantly N-NW and plunge at moderate angles. Offset of broken grains suggests dextral shear along the CS foliation. Metamorphic foliation is commonly folded and deflected around porphyroblasts in the schist suggesting deformation outlasted metamorphism.

The CP contains xenoliths of schist lithologically similar to the host CS implying that emplacement of the pluton was a post-metamorphic event. The NW trend of the regional metamorphic fabric in the area is crosscut and deflected by the CP. The pluton lacks a solid-state fabric but bears a magmatic foliation at its southern margin. The magmatic foliation is defined by parallel alignment of primary igneous minerals and lenticular microgranitoid enclaves. The magmatic foliation is most pronounced at the margins of the pluton and is parallel to the CS-CP contact. Along the southern CS-CP contact, foliation in the CS deviates from the regional NW strike to become E-W, parallel to the margin of the pluton. This parallelism of fabric may be due to rotation of the CS foliation during emplacement of the CP. Along the northern external contact of the pluton however, the CS foliation retains its NW trend and is at high angles to the pluton.

Zircons from samples collected from the northern and southern margins of the pluton have identical concordant U/Pb ages of 92 Ma. Along the southern CS-CP contact a thin, non-deformed quartz-dioritic dike crosscuts the metamorphic foliation of the CS. Two zircon fractions from this dike have nearly concordant U/Pb zircon ages of 93 Ma. Metamorphism and fabric development in the CS in the Huckleberry Mountain area thus occurred prior to 93 Ma.

No 16145

COMPLEX METAMORPHIC AND STRUCTURAL HISTORY OF TWO FRANCISCAN TERRANES IN THE NORTHERN DIABLO RANGE, CALIFORNIA

BLAKE, M.C., Jr., FISHER, G.R., SORG, D.H., MURCHEY, B.L., and ELDER, W.P.

U. S. Geological Survey, 345 Middlefield Rd. MS 975, Menlo Park, California 94025

New geologic mapping in the northern Diablo Range portion of the San Jose 1:100,000 quadrangle indicates that two Franciscan terranes having different sandstone compositions were deposited on oceanic crust of different ages, subducted under different blueschist-facies metamorphic conditions, and subsequently imbricated by low-angle normal(?) faults.

The Burnt Hills terrane (BHT) is structurally highest and consists of metamorphosed arkosic sandstone, mudstone, and minor conglomerate that were deposited on basalt and chert. This chert has yielded poorly preserved radiolarians of Early Cretaceous age. Inoceramid bivalves and ammonites from the overlying clastic sediments indicate a Late Cretaceous (late Santonian - early Campanian) age.

The structurally lower Eylar Mountain terrane (EMT) consists largely of metamorphosed sandstone that also was deposited on basalt and radiolarian chert. EMT sandstone (metagraywacke), however, is noticeably more lithic than BHT sandstone. A single *Buchia* (*Ischeriana*) from EMT metagraywacke is of Late Jurassic (Tithonian) age. Radiolarians from EMT chert are also of Late Jurassic age. Zones of melange that seem gradational with coherent EMT rocks were probably derived from a more fine-grained, argillite-rich facies of the terrane. These melanges contain numerous tectonic blocks of blueschist but do not appear to be spatially related to low-angle faults bounding the two terranes.

D. S. Cowan and R. M. Morrell previously documented a remarkably narrow (~1 km) zonation of metamorphic minerals in metagraywacke in the BHT. Our studies indicate that this zonation is interrupted by structural discontinuities such that textural zone TZ-1 pumpellyite-albite metasandstones and their basal basalt-chert are structurally on top of another metasandstone slab (TZ-2A) containing albite-lawsonite ± pumpellyite ± glaucophane ± jadeite pyroxene.

1000 482