NORTHERN CALIFORNIA GEOLOGICAL SOCIETY

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MAY 2003 MEETING ANNOUNCEMENT

DATE: **Wednesday, May 28, 2003**

LOCATION: **Orinda Masonic Center, 9 Altarinda Rd., Orinda**

TIME: **6:30 p.m. Social; 7:00 p.m. talk (no dinner)**
Cost is $5.00 per person

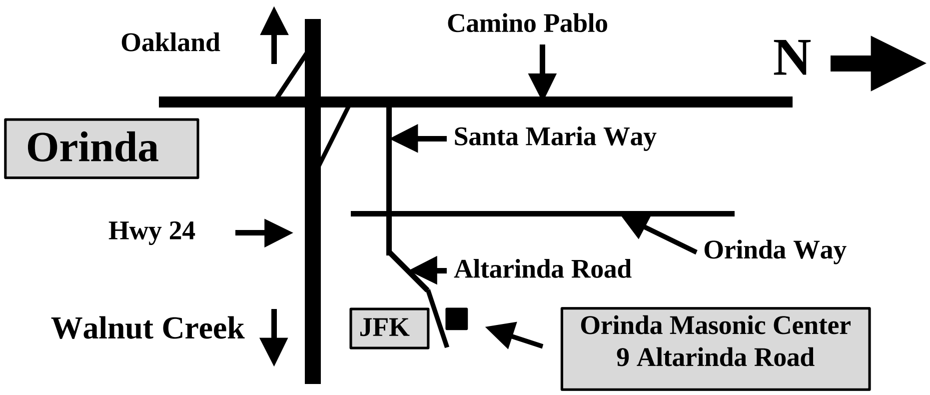
RESERVATIONS: Leave your name and phone number at 925-424-3669 or at *danday94@pacbell.net* before the meeting.

Speaker: Dr. Ian Carmichael, Department of Earth & Planetary Science, University of California, Berkeley

The Andesite Aqueduct: Examples From Western Mexico

Characteristically porphyritic andesites (57-65% SiO_2) form large central volcanoes in the Mexican volcanic belt, whereas basaltic andesites (52-57% SiO_2) are less porphyritic, and are found as cones and flows, but are absent from central volcanoes. Experimental phase equilibria of these lavas relate water concentration to the phenocryst assemblages and to the degree of crystallinity, so that the abundance, composition and variety of phenocrysts can be used to constrain the amount of water dissolved in the magmas. Thus the plagioclase-rich andesites of Volcan Colima, Mexico, lose their dissolved water (2.5 to 4.5 wt.% H_20), which is inversely proportional to the modal abundance of plagioclase. The feeding magma to V. Colima, North America's most productive central volcano, is represented by hornblende lamprophyre, a lava type without plagioclase phenocrysts, which requires at least 6 wt. % water to reproduce the phenocryst assemblage. Thus degassing of the V. Colima magmas, and of those of the other central volcanoes in the western-central Mexican volcanic belt, contributes essentially all their dissolved water to the conduit or to the atmosphere.

The source of this magmatic water is related to the source of the intermediate magmas. For some magmas this must lie in the mantle as the incorporation of hornblende-lherzolite nodules in a hydrous andesite with hornblende phenocrysts, could only have occurred while ascending through the mantle. If the lower limit of water dissolved in Mexican intermediate magmas is accepted as that required for phenocryst equilibration (~6 wt. % water), and the upper limit as saturation in the mantle source at 1 GPa (~16 wt. %), then with an estimate of the volcanic and plutonic magma delivery rate (km^3/my) per km of volcanic arc, the flux of water returned from the mantle along the 35,000 km global subduction-related arc system can be estimated. Of the magma flux ascending to the continental crust, only about a tenth reaches the surface. If the dissolved magmatic water limits are coupled with the volcanic and plutonic emplacement rates, then the amount of water returned by magmatism to the crust is crudely in balance with that subducted.



Dr. Ian Carmichael continues to pursue a distinguished career in igneous petrology and volcanology at the University of California - Berkeley. Dr. Carmichael and his 29 Ph.D. students have conducted extensive field and laboratory research including experiments at high temperatures and pressures, geochronology, physical and analytical chemistry, fluid mechanics, tectonics and microscopic analysis. He has received numerous awards and honors including being elected as a Fellow to the Royal Society of London and receiving the Murchison Medal from the Geological Society of London, the Schlumberger Medal from the Mineralogical Society of Great Britain, the Arthur. L. Day Medal from the Geological Society of America, and the Bowen Award from the American Geophysical Union. He has served in several academic posts such as Acting Provost for Research, Associate Dean for Academic Affairs - Graduate Division, and Chairman - Department of Geology & Geophysics. Since 1996, he has also been a director for the Lawrence Hall of Science.

Northern California Geological Society
c/o Dan Day
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Would you like to receive the NCGS newsletter by e-mail? If you are not already doing so, and would like to, please contact **Dan Day** at danday94@pacbell.net to sign up for this service.

NCGS 2002-2003 Calendar

Wednesday, May 28, 2003
Dr. Ian Carmichael, University of California Berkeley
The Andesite Aqueduct: Examples From Western Mexico
7 pm at Orinda Masonic Center

Wednesday, June 25, 2003
Carol Prentice, USGS, Menlo Park, CA.
***San Andreas Fault* (Exact title to be announced)**
7 pm at Orinda Masonic Center

Upcoming Field Trips…

June 6-8, 2003	***Rodgers Creek-Maacama Step-over Area*** 2-day overnighter at Cal Academy Pepperwood Ranch west of Franz Valley	**Bob McLaughlin**, USGS, **Andrei Sarna-Wojcicki**, USGS **Dave Wagner**, California Geological Survey and others
August 2, 2003	***Clear Lake Volcanic Field***	**Rolfe Erickson**, Sonoma State
Summer / Fall 2003 (TBA)	***Devil's Slide / Pebble Beach or Pigeon Point***	**Scott Morgan, Morgan & Jody Castle** of Earth Mechanics
October 11, 2003	***Point Reyes Area***	**Tom MacKinnon,** Consultant
November 2003	*Mt. Burdell (with a hike to the top!)*	**Rick Ford**, SFSU Graduate Thesis
Summer 2004 (TBA)	***Northern California Gold Belt, Quincy*** *(BLM has put all travel on hold)*	**Gregg Wilkerson**, BLM

Bay Area Geophysical Society

Although this talk has already been given the details of the talk may be of interest to our members. Future talks have not yet been posted to the BAGS website (see below).

May 15, 2003 BAGS Luncheon: T*he Successes, Discoveries and Future of GeoHazards International in Improving Global Earthquake Safety*, presented by Brian E. Tucker, GeoHazards International. A summary of the talk can be found at **http://sepwww.stanford.edu/bags/Talks**

Social and Lunch: 11:30 a.m. in the ChevronTexaco cafeteria.
Talk: 12:30 p.m. in Room D-2153, ChevronTexaco Park, 6001 Bollinger Canyon Rd., San Ramon, CA.

No charge for this program.
Buy your own lunch in the ChevronTexaco cafeteria.

Note: Non-ChevronTexaco employees RSVP to **rmfi@chevrontexaco.com** or phone **Robert Fiore** at **925-842-6497** by noon Wednesday, May 14th. ***This must be done to ensure that you get a visitor's pass***.

Please check the BAGS website **http://sepwww.stanford.edu/bags/** *regularly for meeting notices and updates.*

NORTHERN CALIFORNIA GEOLOGICAL SOCIETY

GEOLOGY OF THE RIGHT STEPOVER REGION BETWEEN THE RODGERS CREEK, HEALDSBURG NORTHERN SAN FRANCISCO BAY REGION

June 6-9, 2003 Weekend

Trip Leaders:

Bob McLaughlin, USGS;
Dave Wagner, CGS; and Andrei Sarna-Wojcicki, USGS
with graduate students and faculty from
San Francisco State and San Jose State Universities

Participants have the option of arriving on Friday evening, June 6, for some dinner, chatting with colleagues and friends, and sleeping over at the Pepperwood Preserve. The field trip will officially begin Saturday morning June 7 at the Pepperwood Ranch Natural Preserve facility of the California Academy of Science, located northwest of Mark West Springs-Porter Creek Rd, west of Franz Valley, and northeast of Santa Rosa.

On Saturday June 7th, the first day of the field trip, geologists from the USGS will focus on stratigraphy, sedimentology and deformation of late Miocene to Quaternary fluvial-lacustrine deposits and volcanic rocks in the northern part of the field trip area. We will look at the Maacama fault, and visit exposures used to constrain paleoflow and provenances of clasts in Plio-Pleistocene gravels, discuss the geochronology and tephrochronology of the volcanic rocks and the constraints that this data place on the timing of initiation, the amount and rates of long-term offset on the active strike-slip faults of the right-stepover area between the Rodgers creek and Maacama faults. We will also discuss how the strike-slip system interfaces with somewhat older but still active thrust faulting, especially in the area east and southeast of Franz Valley.

The Sunday June 8th, we will look at the geology and tectonics of the southern Sonoma Mountains featuring the Rodgers Creek, Tolay and related faults as well discussing the results of new geologic mapping, trenching, tephrochronolgic correlations, and radiometric dating.

Logistics: To be more flexible with members' schedules, the Pepperwood Field Camp has been setup for either Friday evening or Saturday morning arrivals. The drive up to the Pepperwood Field Camp is about 2 hours. Continental breakfast will start at 7am, along with a ‘pack-your-own-lunch’ setup. Bob McLaughlin and Dave Wagner will start at about 8 am Saturday, so depending on your work schedule or personal preference, you can come up to Pepperwood to arrive at the field camp from 6 pm Friday through 7:45 am (some time to pack your lunch) Saturday.

Participants who overnight at the Pepperwood on Friday and Saturday nights (June 6 and 7) will need sleeping bags and ground cloth. Backpacking tents would be an option for keeping the dew off for those preferring not to sleep under the stars. There's also a large front room floor area with fireplace and a large covered deck where folks can throw their bedrolls down. There are 2 bathrooms, each with one toilet and each with a stall shower. Everyone should plan on having their own towels and toiletries.

This Academy of Sciences Field Campus has a dining hall with a kitchen to prepare meals. Some NCGS members have offered to set up the meals, but plan on helping out with cooking and dishes. You may opt to stay in a nearby town (Calistoaga or Santa Rosa) and still partake in the dining and after field trip discussions. If the non-fire conditions are favorable, we will have a Saturday night campfire.

Things to bring: Sleeping bag, ground mat, pillow (tent if you want), towel, warm clothes for the evening. Be prepared for some off-trail hiking, including a pack to carry your lunch and beverage. Hiking boots; don't forget sun protection.

THIS FIELD TRIP WILL BE LIMITED TO 30 PEOPLE

******************** REGISTRATION FORM --- Please rsvp by Saturday, May 31st ********************

Name ______________________________________Address

Street/City/Zip)______________________________________

Phone (day) ___________________ Phone (evening) _____________________ E-mail or Fax No. __________

Driving/carpooling: We will try to create car pooling groups for migrating up to Pepperwood from people attending, once all of the rsvp's for the trip are in the week before the field trip. We will be condensing into a smaller number of vehicles and carpooling from Pepperwood field camp to the field trip locations.

Indicate if you are willing to drive (gas cost shared by riders) _____

Would like to arrive: Friday night ____ Saturday morning ____

Would like to: carpool ____ drive up on my own ___

Cost:

Cost depends on camping arrangements and arrival time. Deduct $10 if you arrange for staying in a nearby hotel. If you plan on arriving Friday night and having some dinner, add $10, tally the fees, and submit a check with the appropriate total amount (from $60 to $80).

Lodge / camping facilities		
Weekend camping, lodge access ($10 if not staying at Pepperwood)	20.00	_X_
Friday		
Friday dinner	10.00	___
Saturday		
Saturday breakfast and pack your own lunch	12.00	_X_
Saturday dinner	10.00	_X_
Sunday		
Sunday breakfast and pack your own lunch	12.00	_X_
General		
Field guide, refreshments, misc items	16.00	_X_
Shared gas, to be determined by drivers		
Indicate if you are a vegetarian		____
Indicate if you are a nonmember (add $10 to cost)		____

Please mail form and a check made out to NCGS to: **Jean Moran, P.O. Box 1861, Sausalito, CA. 94966**.
If you have any questions or need additional information, e-mail Jean at **jeanm@stetsonengineers.com**
or call **415-331-6806** (evening).

Due to family obligations, Jean will not be available on Thursday, June 5 – Sunday, June 8. If something comes up at this late time, please call **Rob Nelson, 707-795-8090** in Rohnert Park – he will have the roster and will be managing the logistics for the trip starting Thursday, June 5.

Directions to the Pepperwood Ranch Natural Preserve/California Academy of Sciences 3450 Franz Valley Road, Santa Rosa, CA 95404

From Santa Rosa:

- Going north on Hwy 101, about one mile from the northern outskirts of Santa Rosa,
- Exit onto River Road.
  Turn right and proceed east about 6 /12 miles
  (the road name will change to Mark West Springs Road then to Porter Creek Road).
- Turn left of Franz Valley Road and go uphill one mile to Pepperwood Ranch.

From Calistoga:

- Go north on Hwy 128 (Foothill Blvd) 1 mile.
- Turn left (west) on Petrified Forrest Road and go 5 miles.
  Go past Franz Valley School Road and the Petrified Forrest.
- Turn right on Porter Creek Road and go 3 miles to Franz Valley Road.
- Turn right on Franz Valley Road and drive uphill 1 mile to Pepperwood Ranch.
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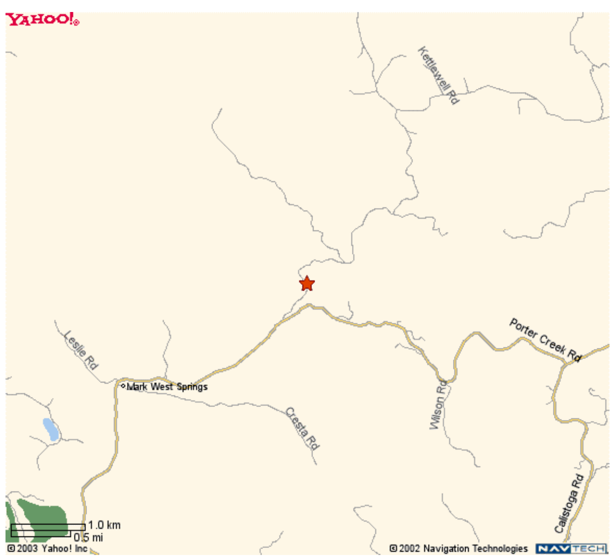

A Tale of Two Uplifts

When guest speakers are compelled to cancel their engagements, the resulting turmoil can be stressful to a program chair. However, last month's NCGS agenda was rescued by new father, and renowned Bay Area neotectonics expert **John Wakabayashi**. John is well known for his enthusiastic demeanor for all things (plate) tectonic, and also shares a passion for high Sierra fishing and beer brewing. John filled-in at the April 30th NCGS meeting with a recap of his scholarly work on Sierra Nevada uplift with colleague Thomas Sawyer entitled ***"The Tale of Two Uplifts: Tectonics and the Evolution of Sierra Nevada Topography."***

John has been enthralled with the Sierras since he made his first trip into the high country with his father in 1966. It seems he has always come back to this beautiful mountain range both for recreation, its scenic beauty, and to unlock the secrets of its evolution. It seems the uplift of the Sierra Nevada range has intrigued geologists for over a century. The classic work on the Sierran uplift was published by Waldemar Lindgren in 1911. He compared the difference in stream channel slopes of the southwest-flowing bedrock profiles of reconstructed Tertiary meandering rivers with their northwest-flowing segments. Lindgren surmised that the southwest-flowing segments would show the steepest gradients, whereas the northwest-trending channels would show the least amount of tilt because they roughly paralleled the apparent tilt axis of the uplifted range. By subtracting the two gradients, he calculated an uplift along the range crest of 3600 to 4900 feet between the headwaters of the Yuba and Mokelumne Rivers. With minor variations, this theme had been considered dogma until recent years, when the concept of westward sloping Sierran tilt-block theory was challenged by retired U.C. Berkeley professor Davey Jones, and a group of Caltech geoscientists. John jumped into the melee on the side of traditional thinking because he felt the newer schools of thought had simply ignored conventional wisdom—and a wealth of evidence in the geological record that supported late Cenozoic tilt-block style uplift of the range.

John's presentation began with photos of an adolescent version of our speaker enjoying the scenery and geology in the High Sierra. At a young age he was obviously taken by this magnificent range, and its spell had a strong influence on his elected career as a geologist. So John would seem to be a natural choice to conduct a detailed examination of Sierran uplift. The Sierras have an intricate history, however. The range is part of the Sierra Nevada microplate, a subregion of the North American plate that includes California's Central Valley. The microplate is internally intact but displays strong deformation at its margins. On the west it is bounded by a currently active fold an thrust belt marking the eastern margin of the Coast Range province. Its steep eastern eascarpment marks the Sierra Nevada frontal fault system, a zone comprised of normal, normal-dextral, and dextral (right lateral) faulting. The latter is considered the westernmost part of the dextral Walker Lane Belt (fault system) that separates the Sierra Nevada microplate from the Basin and Range Province and the North American plate proper. Dextral Sierra Nevada microplate movement is 10 to 14 mm/yr subparallel to the plate boundary.

The Sierras are the by-product of plate convergence and subduction during Mesozoic and Cenozoic arc activity, which blanketed the Sierras in volcanic debris as far south as the Stanislaus River drainage basin. Volcanism migrated northward as the Mendicino triple junction migrated northward and the convergent plate margin became a transform fault system about 5 million years ago. Currently the northern Sierras slope gently westward from the range crest and steeply eastward from this point. The westward gradient is gentle in the northern range the slope steepens in the western foothills. The range crest is at an elevation of 2100 to 2700 meters in the northern Sierras and at 4000 to 4400 meters in the central to southern end. And the eastern escarpment is 1000 meters high in the north to almost 3300 meters high near Lone Pine where Mt. Whitney caps the range.

The early studies of Sierran uplift concluded that most of the uplift and tilting was a late Cenozoic phenomenon. This was supported not only by geomophological evidence, but by paleobotanical and climatological evidence from Miocene floras in Nevada which suggested the Sierras were much lower then. However, the timing of Cenozoic uplift requires a Cenozoic cover, and this is restricted to the range north of Tuolumne River. Here the Mesozoic plutons are overlain by Eocene Auriferous Gravels, Oligocene rhyolite tuffs (Valley Springs and Delleker Formations), and upper Miocene andesitic deposits and mudflows (the Mehrten Formation). Key to the initiation of significant stream incision and faulting is the age of the upper Mehrten. Although the subject of debate (ages range from less than 4 to 6.8 m.y. north of the Yuba), John selected 5 m.y. as its age for purposes of establishing range-wide uplift rates. Late Cenozoic incision rates can be estimated by measuring the elevation difference between present day stream channels and the tops of interfluvial (land between the streams) deposits capping the ridges, then dividing by the age of the youngest deposits. This is referred to as "total incision." Similarly, the difference in elevation between the base of Late Cenozoic volcanics and the canyon bottoms is referred to as "basement incision." The latter provides a minimum incision rate because the time needed to cut through the volcanics is ignored. Uplift rates were estimated by measuring Miocene stream gradients and subtracting the original (restored) stream profiles relative to the uplift "hingeline" from the modern paleostream profiles to calculate the net uplift of the Sierran crest.

Paleorelief must also be taken into account when evaluating the Sierran uplift. It can be estimated by comparing the elevation of basement rock topographic highs relative to the base of Cenozoic strata in the vicinity. This is a minimum estimate of the relief that predated Late Cenozoic stream incision. Although the southern Sierra Nevada contains only scattered outcrops of Cenozoic strata, there is enough evidence to indicate that its paleorelief is considerably greater than the northern end of the range.

There have been at least three methods, including the one used by John and his colleague, to calculate the incision rate and total Late Cenozoic (Upper Miocene to present) uplift of the Sierra Nevada range. All of these techniques result in uplifts of 1440 to 2150 meters. The most reliable estimates, in John's opinion, fall between 1710 and 1930 meters. During a study he conducted for PG&E, John was fortunate enough to find multiple basalt flow terraces exposed in the canyon of the North Fork of the Feather River. The four flow remnants were dated at 2.8 m.y., 2.1 m.y., 1.1 m.y., and 0.6 m.y., and showed a progressive decrease in age with decreasing elevation on the canyon wall. The flows were obviously emplaced at various times as the river cut into the canyon, and gave John some excellent control on the incision rate along this drainage system. Other reliable uplift rates can be determined using extensive reaches of the Lovejoy Basalt (1710 to 1860 m uplift), the Table Mountain Latite (1790 to 1930 m uplift), and the ancestral San Joaquin River in the southern Sierras (2150 m). There is also little difference in uplift calculated for points between the Feather River and the Kings River, which likewise agrees with uplifts based on paleobotanical evidence. The measured paleorelief differences between the northern and southern parts of the Sierras approximates present day elevation differences between the two regions. In the northern part of the range, the stream incision greatly exceeds the paleorelief, whereas in the southern Sierras the opposite is true. If negligible Late Cenozoic summit surface erosion, or elevation loss, has occurred based on an extrapolation of Late Quaternary erosion rates, then the paleorelief calculated by subtracting Late Cenozoic total uplift from present elevations gives maximum paleorelief of <900 m north of the Yuba River, and >2000 m maximum paleorelief south of the Stanislaus River. It should be noted that additional evidence of intense periods of erosion, and hence, Sierran uplift, has been quite well preserved in the sediments of the Great Valley.

John's extensive work in the Sierras with colleague Thomas Sawyer involved more than just the calculation of uplift and incision rates. He has spent an extensive amount of time studying the neotectonics (recent tectonism) on the Frontal Fault System/Walker Lane Belt that borders the eastern margin of the Sierran microplate. John has integrated this tectonic work into his uplift study, and has devised a speculative chronology for the development of the Sierra Nevada range. It begins while the Cretaceous Sierra Nevada magmatic arc was still active. A major pulse of erosion and associated surface uplift began about 100 m.y. ago. High erosion rates persisted until ~57 m.y. ago, or about 25 m.y. *after* the cessation of Cretaceous arc magmatism. The sedimentary record in the Great Valley suggests the highest uplift rates occurred between 100 and 84 m.y. and coincides approximately with the final stages of pluton emplacement in the Sierra Nevada batholith. The tectonic deformation associated with 100 to 57 m.y. exhumation event differed from the Late Cenozoic westward tilting. Pluton exhumation is greatest in the western range, whereas the Late Cenozoic exhumation is greatest in the east near the ridge crest. The Late Cretaceous exhumation of deep-seated western plutons may have happened before the youngest Sierran plutons were emplaced, and the exhumation may have progressed eastward with time. From 84 to 45 m.y., Laramide deformation and crustal thickening occurred in the Great Basin, and the southern Sierras experienced a decrease in relief up to the end of the 100 to 57 m.y. erosional event. It has been suggested by other workers that the drop in elevation may be related to eclogite rock crystallization in the deep root of the range, causing it to sink. Crustal thickening in Nevada during the Laramide orogeny may have elevated the proto-Great Basin, providing a source for the rivers that drained westward and deposited the Eocene gravels. The occurrence of these gravels only north of the Stanislaus River suggests that the higher southern Sierra Nevada may have been a topographic barrier to the rivers at this time. The paleorelief differences between the northern and southern parts of the range cannot be clearly explained, but may be due to 1) less surface uplift in the northern range at 100 to 57 m.y.; 2) differences in the deep crust or mantle along the range axis; or 3) earlier cessation of uplift in the northern range, allowing more time for it to erode before deposition of the Eocene gravels. Basin and Range extention commenced about 35 m.y. east of the northern Sierras and had progressed to the southern range by 20 m.y. ago. The Walker Lane Belt had begun progressing westward toward the Sierras but westward tilting was delayed until 5 m.y. ago. Volcanic arc activity started up again at 34 m.y., but regional arc activity initiated with the Mehrten volcanics at 14 m.y., again with no detectable range uplift. Uplift, westward tilting, and east-down frontal faulting began, and large-scale volcanism ceased, ~5 m.y. ago. These events were closely timed with a dextral component of motion between the Sierra Nevada microplate and the North American plate as the relative motion between the Pacific and North American plates shifted from a subduction mechanism to the current strike-slip/transpressional regime.

The NCGS deeply appreciates John Wakabayashi's willingness to present his work to its members on short notice. The bulk of his talk is covered in a recent article by Wakabayashi and Sawyer (2001) in the Journal of Geology, Vol. 109, pp. 539-562. John and Tom Sawyer also published a prelude to this work on Neotectonics of the Sierra Nevada and the Sierra Nevada-Basin and Range Transition in "Field Guide to the Geology and Tectonics of the Northern Sierra Nevada," DMG Special Publication 122 (2000).