

EarthScope: Educational programming in Museums ... "Science Cafes"

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Acknowledgements

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EarthScope is constructed, operated, and maintained with UNAVCO, Inc., IRIS, and Stanford University, with contributions from NASA and several other national and international organizations.

New Mexico Museum of Natural History and Science and partners:

New Mexico State Library, KNME, New Mexico Tech, U.S.G.S. and UNM **Statewide Science Café** model funded by an E&O grant from IRIS, courtesy of John Taber, E&O Program Manager.

Teacher Workshop funded and presented by UNAVCO and IRIS







science for a changing world





Foundation









Why EarthScope?

Geoliteracy

- Geology and geophysics are frequently perceived as "difficult to understand" by the general public
- BUT geologic landscapes are popular tourist attractions
- AND there is great interest in earthquakes, volcanoes, mountains, and natural resources
- AND in local connections and newsworthy programs and projects
- •Therefore, the EarthScope Project is a perfect opportunity to excite and educate the general public about the geosciences





Museum Public "Explorations" Programs



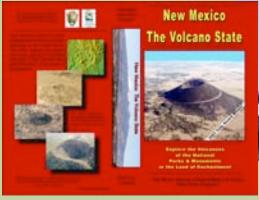
Geoliteracy

How does the public learn about geological research and geoscience topics? About EarthScope?

- Universities?
- Web sites?
- News media?
- Special publications?
- Local museums, state parks, science centers, nature/education centers, NPS parks and monuments?



Museum education poster uses landscape to teach geology







Our Advantage

Informal science education centers serve a wide and diverse audience.

- Graphics/display expertise
- Accessible, visitor-friendly and non-threatening
- Pre-K through Senior Citizen
- Underrepresented populations
- Flexibility in approach
- Abstract or theoretical concepts linked to object-based learning
- Community resource for science information
- Link to local scientists and sites



NM Museum of Natural History serves 38% Hispanic 9% Native American





Visitors explore seismicity in our earthquake exhibit Designed in-house, funded by IRIS, partners ASL and NMTech



Why EarthScope?

Scientific Mission...

- Exploration of the North American Continent
- More than a decade-long national geoscience program
- •The largest real-time Earth Science scientific experiment ever!

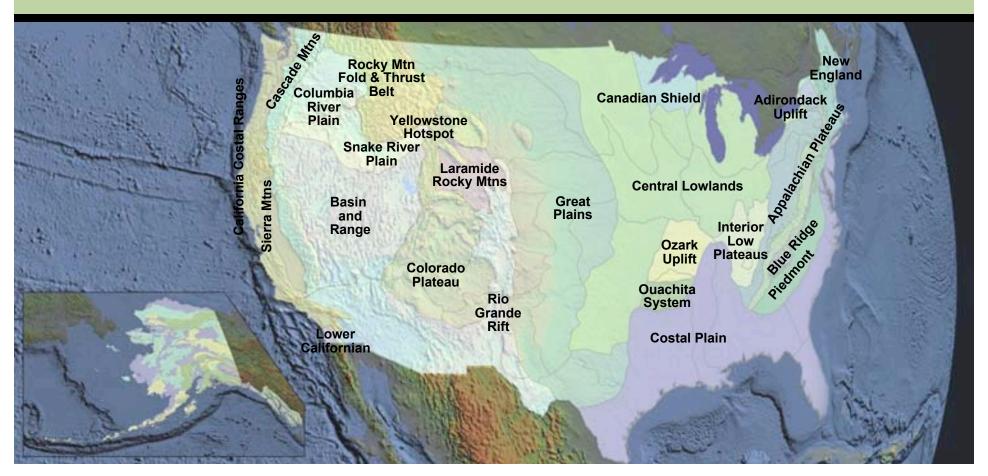




Why EarthScope?

Our Laboratory...

- Plate Boundary Processes large scale
- Individual regions, volcanoes, faults, old mountains small scale
- Diversity of the U.S. Continent...local and regional link





EarthScope - Challenges especially in informal/public programming

- Large-scale, long-term project
- Maps and structural graphics
- 3D and 4D visualization
- Integration across disciplines
- Integration of many data sets
- Many scientific "languages"
- Old crustal terranes and plate boundaries
- Connection between surface and subsurface
- ... Exciting Science... Difficult Science Education...







Why EarthScope?

Scientific Literacy

People are interested - but they do not always understand...

- what it takes to do science
- •why we do it
- how to interpret the data
- •what we ultimately learn.

EarthScope can illustrate the "process of science"!



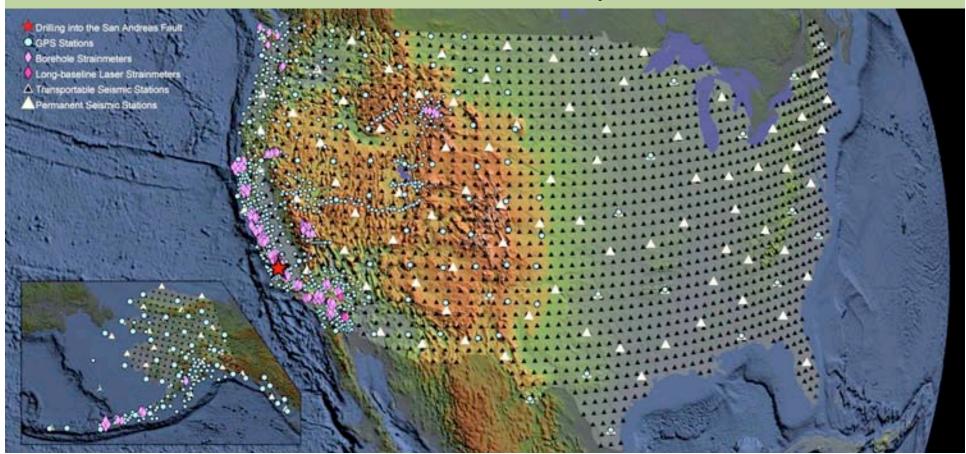


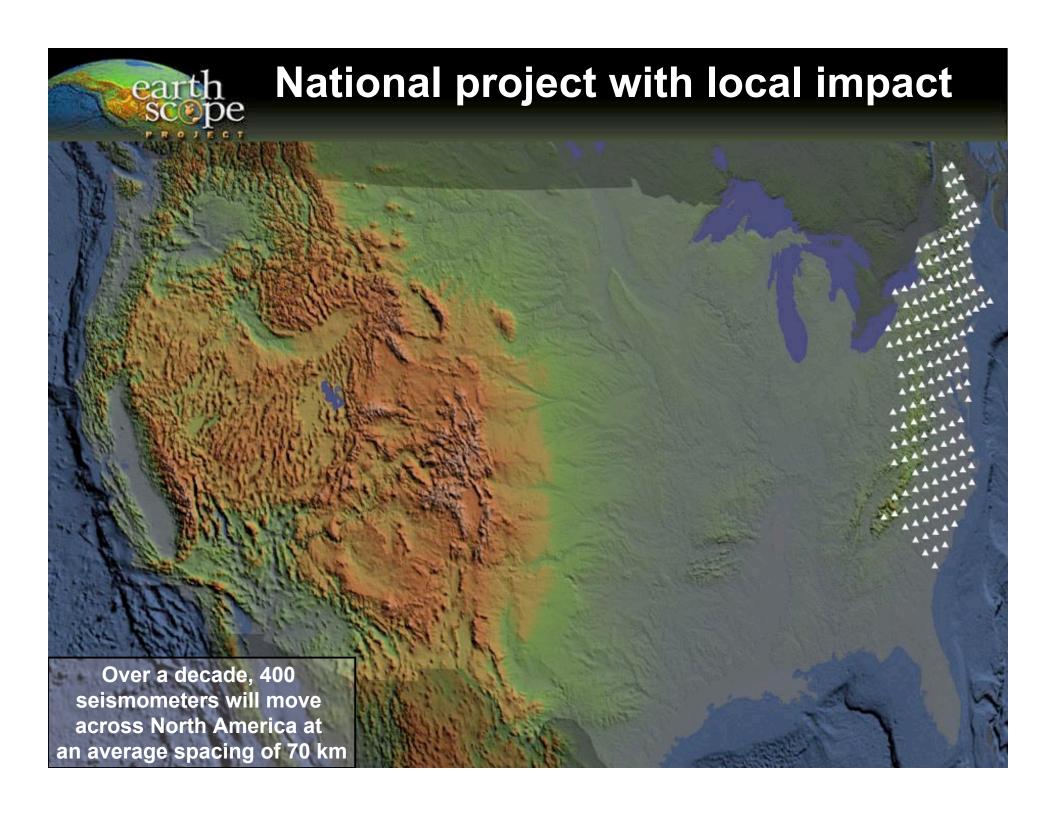
earth scope

EarthScope Instrumentation

- San Andreas Fault
- GPS stations
- Seismic stations
- strainmeters

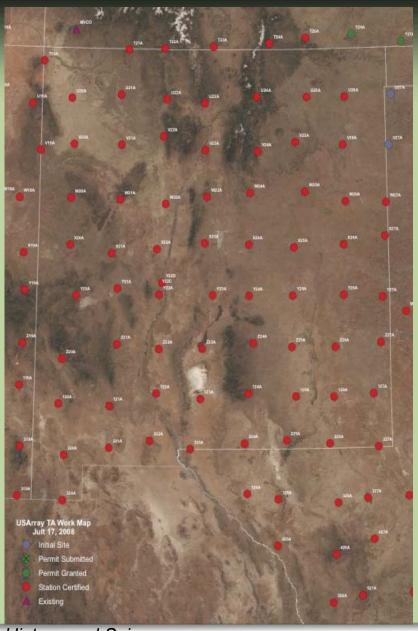
- 400 transportable seismic stations occupying 2000 sites
- Each in place for 18 months
- USArray (Transportable array)
- Installed and operated by USArray/IRIS







USArray in New Mexico





Research on Learning in Museums...

- Self-selected audience
 - ... but also self-directed
- Family/group learning
- Multi-generational
- Visitor circulation/wayfinding
 - ...10 minutes per exhibit
 - ...30 min 2 hrs
- Not a captive audience
- Repeat visits
- Object-based
- Experiential
- On-site and off-site





Exhibits

- Research on learning and movement through public spaces
- Collaboration between scientists, educators, exhibit designers, fabricators, and graphic artists
- Front end, formative and summative evaluation
- Bright graphics and clear examples
- Experiential
- Text scientifically accurate but non-threatening and easy to read
- Layered text newspaper headlines/story vs textbook



Interactive Mars Rover exhibit



Walk-through volcano



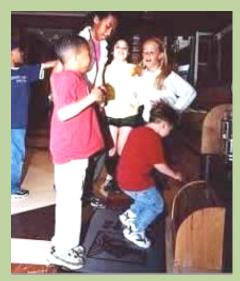
Ice Age mammoth



Museum Exhibits

Permanent Exhibits

Quaking Earth in partnership with IRIS (Incorporated Research Institutions for Seismology)



"Make your own earthquake"



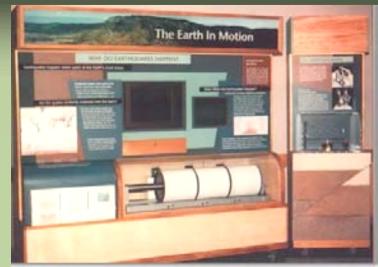




Traveling Earthquake Exhibits

IRIS Traveling Exhibit

- Many visitors are repeat visitors museums and science centers are always looking for good short-term exhibits
- Successful IRIS traveling exhibit developed with partners USGS and New Mexico Museum of Natural History
- Exhibited at museums nationwide beginning in 1998
- Seen by more than 5 million visitors as of 2006



IRIS traveling exhibit built by this museum and seen by millions





Targeted Programs...

- Family Days
- Teacher Workshops
- School outreach
- Adult Lectures/classes





For K-12 Teachers, Museums offer...

- A resource for geoscience information
- Ways to link their students to "real world" science
- Professional development workshops
- Grade appropriate curricula for their students





Teacher Professional Development Workshop Middle - High School Earth and Physical Science Albuquerque, NM





Funded/supported by IRIS and UNAVCO



35 teachers
SF Indian School
Isleta
Laguna-Acoma
Belen
Ruidoso



EarthScope Education Materials

National and State Education Standards

EarthScope will use both earthquides and small explosions to system information don't the Earth's small likely makes an earthquide? How can you tell the difference between an earthquide and a bomb?

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How do we find earthquildes?

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Things for And Jacob

- Even though it will gather information from around the world. Earthdrope is formed on the North American continued.
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- 2. On Hafter has done many things as a scientist, Which of thest would pro most like to do, but? Why?
- Earthfurps will help as protectiond natural facorts, such as earthquakes. Which salural based in most present where you live? What experiment would one design to learn more about IT?
- Business made early processes are very size. Earlideape will decision North America for Milane years. What do not limit they eight have learned at the end of the experiment? How would you have beined them learn that?





EarthScope Education Materials

San Andreas Fault **Observatory at Depth:**

Directly Measuring Earthquakes

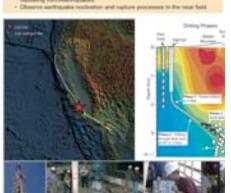
ser's San Andreas Fault Observatory at Depth (SAFOC) is a comprehensive effort to still and instrument a too finact, the San Antheir Fault Zone directly in the area of active earthquake generation. The project will present fundamental questions aloud the physical and chemical processes controlling faulting and earthquakes. The drift sits is on a segment of the San Anthreas Fault that moves through a continuation of earning and repeating microsoftiquates. It less at the extreme roofs and of the number years of the 1905. Magnifults & Parkfield and business the receipt report to a serior of execute first have hardward the fault flux times in this breaton since 1817

Drilling of the Sorehole Inspet on June 11, 2004. The Investok-will extend 3 Jan. repealing microsco-frequence in the Ean Andrean Facult A scale of instruments in the In-Store under which Store plate boundary earthquakes occur.

- Determine structure and composition of the fault pone. Measure street, permeability, and pure pressure conditions in also
- Determine Nictional behavior, physical properties, and chemical process controlling facility through laboratory analysis of fault rooks and fluids.

Extablish a long-term observatory in the fault zone:

- Characterips 3-D volume of shad containing the fault
- Muniter steam, price pressure and temperature during the cycle of represent microearthquaken.



EarthScope Education and Outreach Bulletin: Activity at Augustine Volcano

and two on the rearts maintents.

larger repeatments away from the number of the related. As part of our efforts to uniterstand plate technolis and

The processes associated with it, each as obtained and earthquakes. Earthfloair has installed GPI units throughout Alaska, installing five on Augustine Solvano.

+ bilgs.) (Aut Manage.org./Inducation/Vis/Inspection vis. Anne.phy

AUGUSTRE, ALADRA - Soverors at Earthcope and across the world are excited by record activity on Augustine Volcana, which reaches a peak height of 1.262 to (4.205.10) and in the most active natures in the Clock intel region, Local prints have reported seeing a steam plane that extends at least 75 km (45 m). SE to the southwest, the plane is also pleaty visible. by satellite and an images from the Augustria web names. EarthSupp GPS units installed on the volcans just lend survivar indicate that the volcans appears to he expending on ringing lines through it. Silver as a whole, ultimists are interpreting three pleasheatens as redications that an engineer is likely in the near future.

terriors and narrhqueters, which are recorded on reading percentures. The maginus also causes the chareless to indust this total the soles of the occurrent. The 10t is recorded on the SPS units. When viscoprises engt, selemenaters record a thanatic inclusive in the



EarthScope research

Regional and local











Rio Grande Rift F.A.Q. Measuring Rio Grande Rift Crustal Deformation

Where are there other rifts in the world?

What is the Ro Grande Rift?



is there a risk of earthquakes in or around the Ris

Could there he unknown around the rift?

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The New Mexico Connection







USArray in New Mexico





The New Mexico Connection





Albuquerque Seismological Laboratory ...one of the global seismic network stations!

EarthScope - New Mexico



Did you know?

The EarthScope USArray **Operations Facility for the U.S.** is in New Mexico at NM Tech





Informal science for the community

...a little information

...a face-to-face meeting with an expert

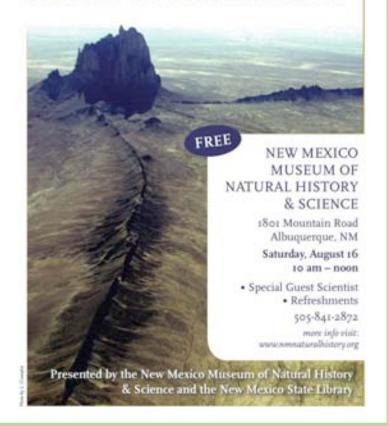
...food

...the opportunity for discussion

In partnership with our local PBS station

Taking the Earth's Pulse

A science café about the Earthquakes & Volcanoes of New Mexico – and the Planet Beneath Our Feet



EarthScope for local communities



The Science Café Model

- Funding by a grant from IRIS E&O
- Aztec, Raton, Clovis,
 Deming and Albuquerque
- Partners: NM State Library and local libraries, KNME-TV, Sandia National Labs, IRIS/Passcal Center and USArray, ASL, NM Tech, and UNM (local research scientists)
- Guests: Rick Aster, Laura Crossey, Karl Karlstrom, John Geissman, and ASL staff









The Science Café Model

- Intro to EarthScope and brief discussion of relevant local geology
- Presentation on EarthScope research
- Extensive Q&A
- Hands-on activities
- Posters and material give-aways
- Food provided locally
- Door prize drawings





Raton, NM Arthur Johnson Memorial Library 48 participants



"turnout for the event was beyond expectations"



Clovis, NM Clovis Carver Public Library 62 participants



"better than anything else we have done for adults"





Aztec, NM Aztec Public Library 122 participants



"knowledgeable presenters and great publicity and posters"



Deming, NM Marshall Memorial Library 90 participants

"our patrons raved about it, EarthScope was the best presentation we ever had"



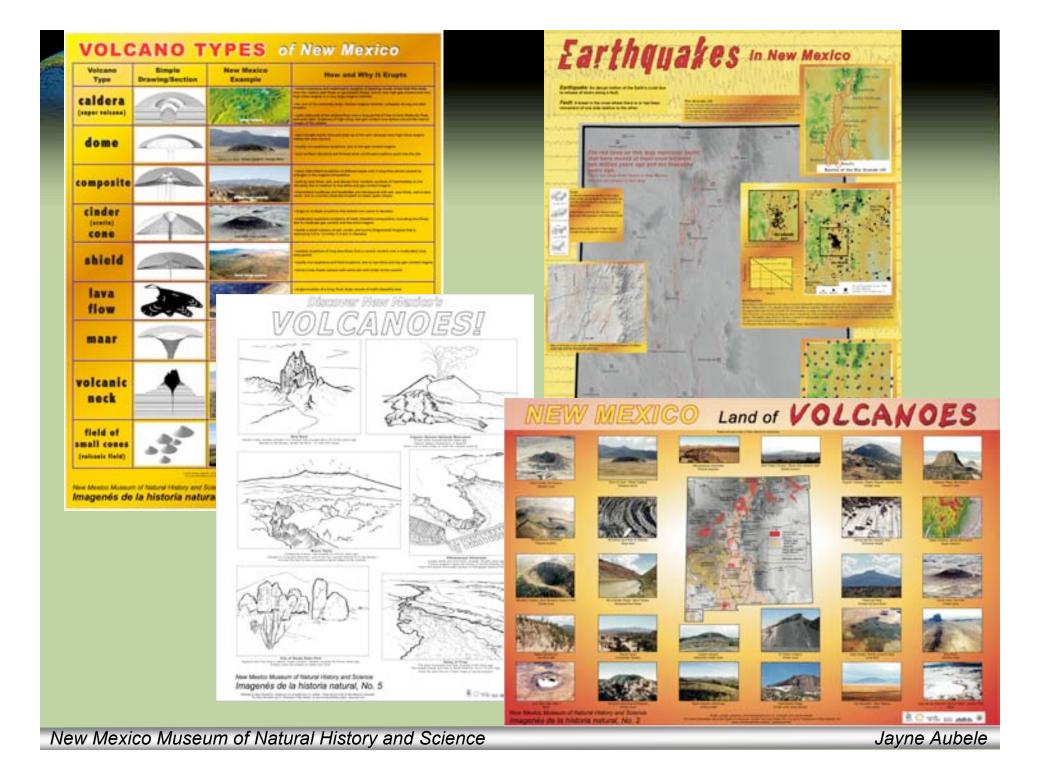
The Science Café Model

Overview and Assessment

- IRIS funding
- Museum staff time (3 months) and vehicle (2000 miles)
- Partnerships
- Logistics
- Museum provided a complete program
- Local libraries generate local connection and increase attendance
- ES researchers able to present their work and connect to the public
- Funds for local advertising, site-specific brochures and locally purchased food
- Professionally developed marketing
- Posters as a continuing teaching tool









The Science Café Model

EarthScope Expenses

Printing
Professional Services
Materials

Food for participants @ cafes

Marketing (ads in local newspapers for each cafe)
Mailing (brochures & posters to libraries/participants)
Travel for Museum coordinators
Salary for Museum logistics assistant (part time)
Travel for EarthScope guest presenters
Stipends for EarthScope guest presenters

Results

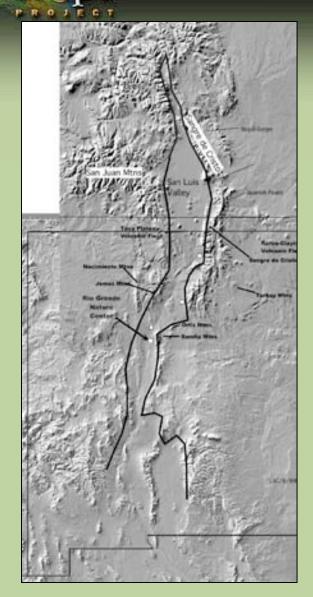
Total café attendance: 402

Library staff: 34

• Local newspaper stories in Raton Range, Trinidad Chronicle News, and Deming Headlight



Revealing New Mexico's Secrets!





Recently active volcanoes and large earthquakes

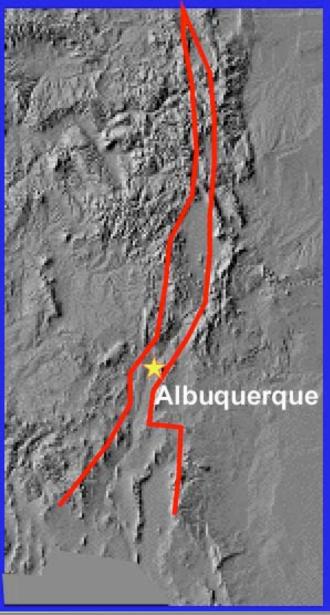


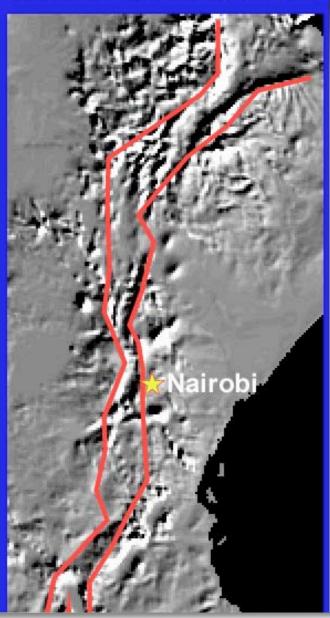
How are the landscape and geology of New Mexico linked?

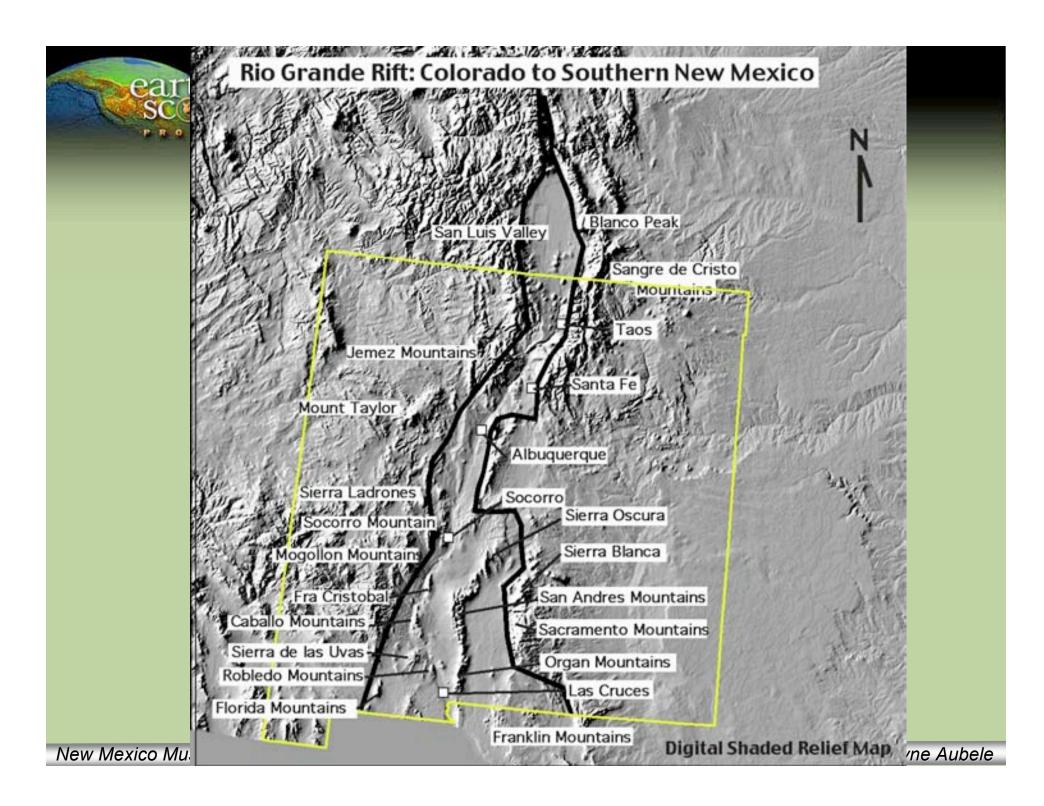


Rio Grande rift

East African rift

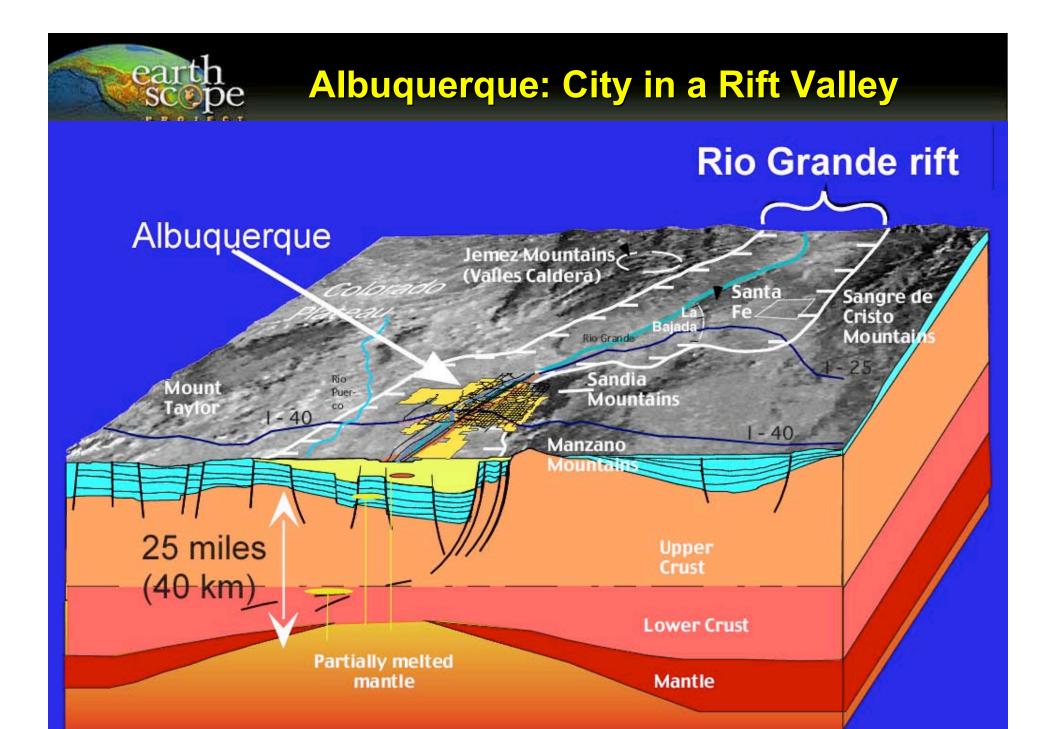






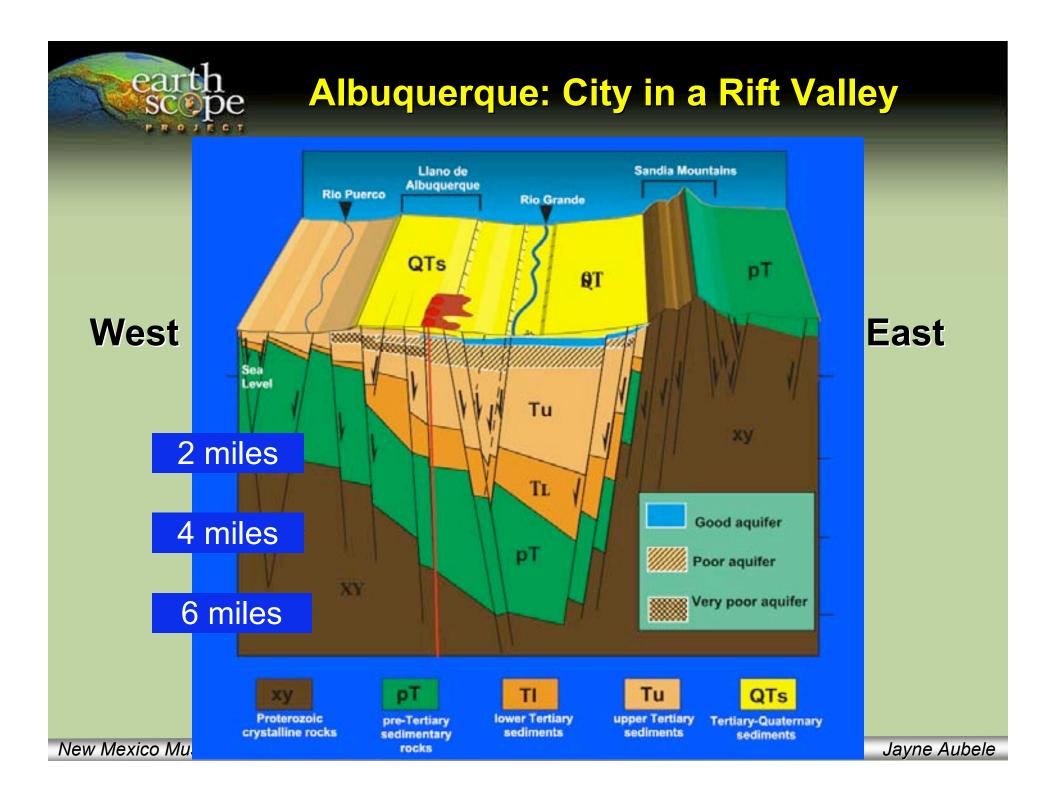






Jayne Aubele

New Mexico Museum of Natural History and Science



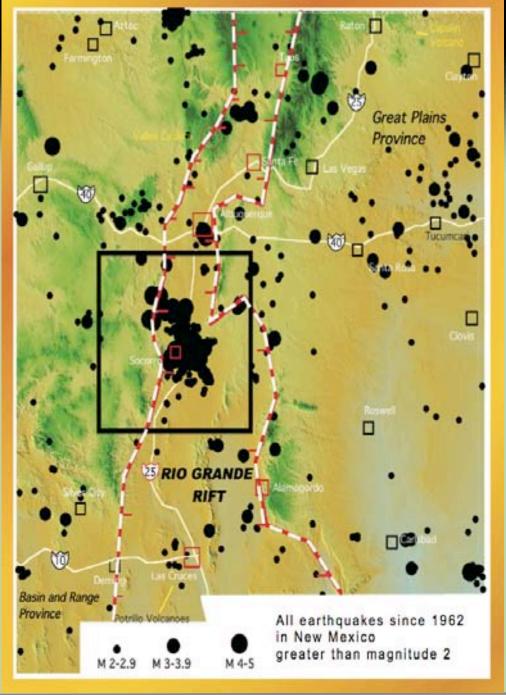
Center of the Rift- Albuquerque Volcanoes



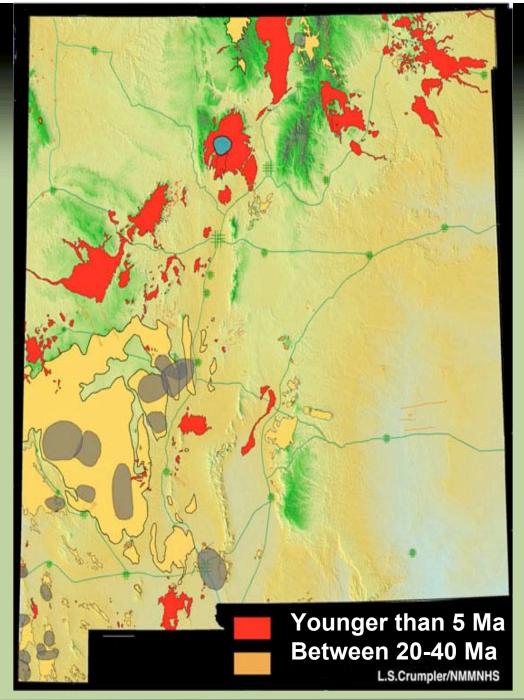
New Mexico Museum of Natural History and Science

Jayne Aubele







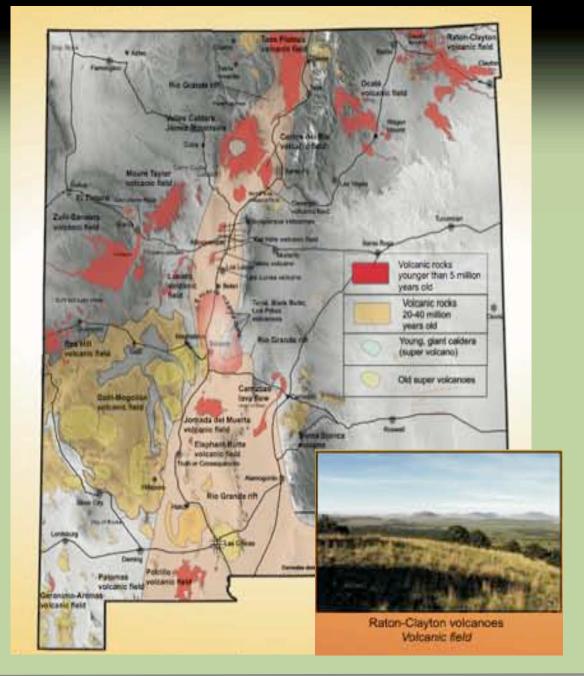


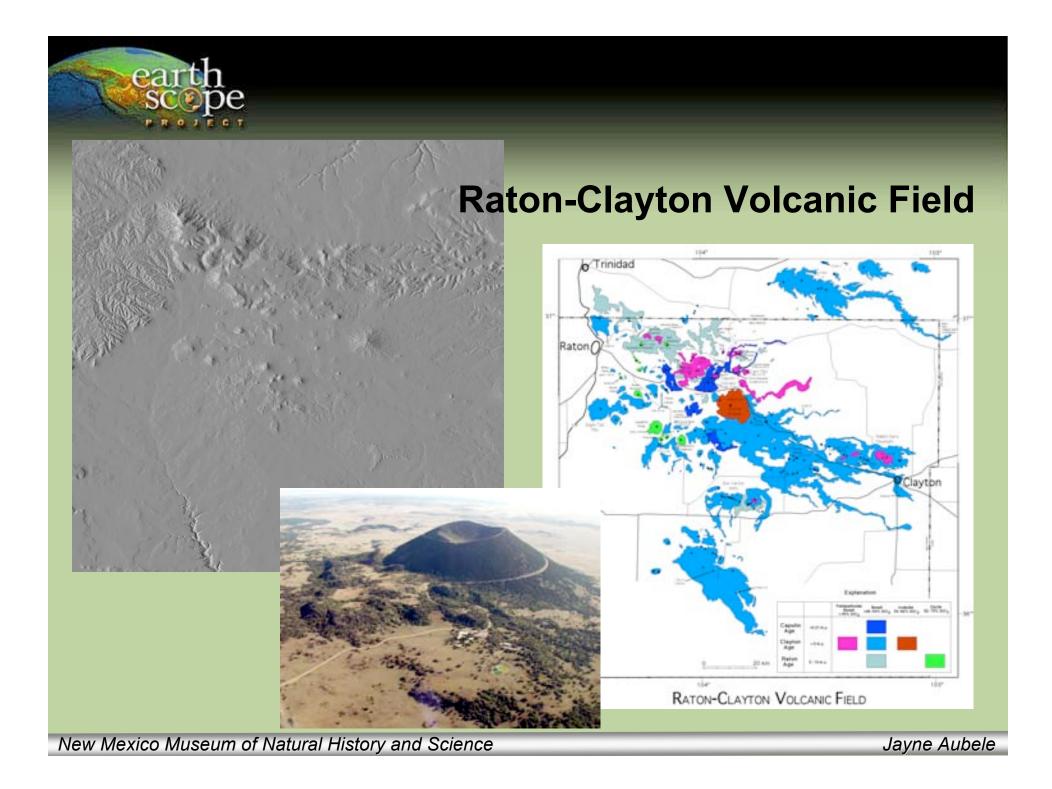
earth	Volcano Type	Simple Drawing/Section	New Mexico Example
earth	caldera (super volcano)		
	dome		Carro La Jaro Wine Colore Annue Mon
	composite		
	cinder (scoria) cone		Cat Hills, Line Lurise
	shield		The later of
	lava flow		MiCortys line flow, El Maljain
	maar		(8)
	volcanic neck		
	field of small cones	200	

(volcanic field)

New Mexico: A Museum of Volcanoes

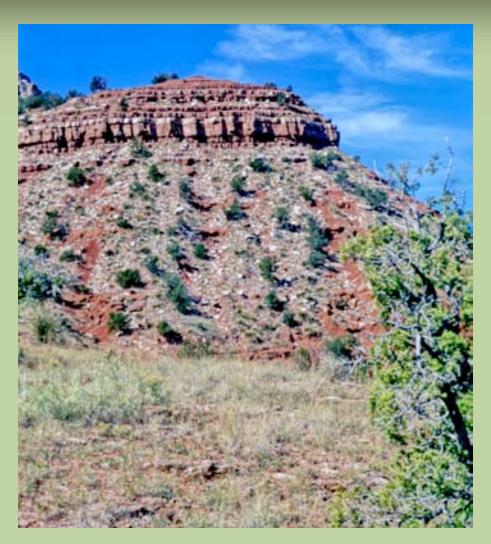








Great Plains (NE High Plains)



Near Tucumcari, NM

Mesozoic Rocks, flat-layered Capped by Tertiary sedimentary rocks And Quaternary volcanism



Capulin Volcano National Monument



Colorado Plateau





Near Grants, NM

Mesozoic Rocks, flat-layered "Layer-cake" geology Eroded mesas Old volcanoes Classic southwest scenery



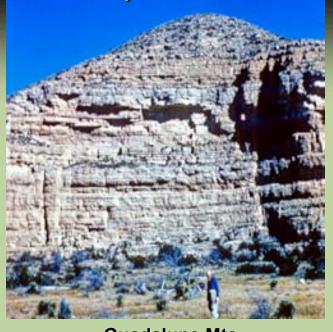
Bisti Badlands

earth scope

Great Plains (SE Llano Estacado)



Paleozoic Rocks... flat-lying.. capped by Tertiary sediments



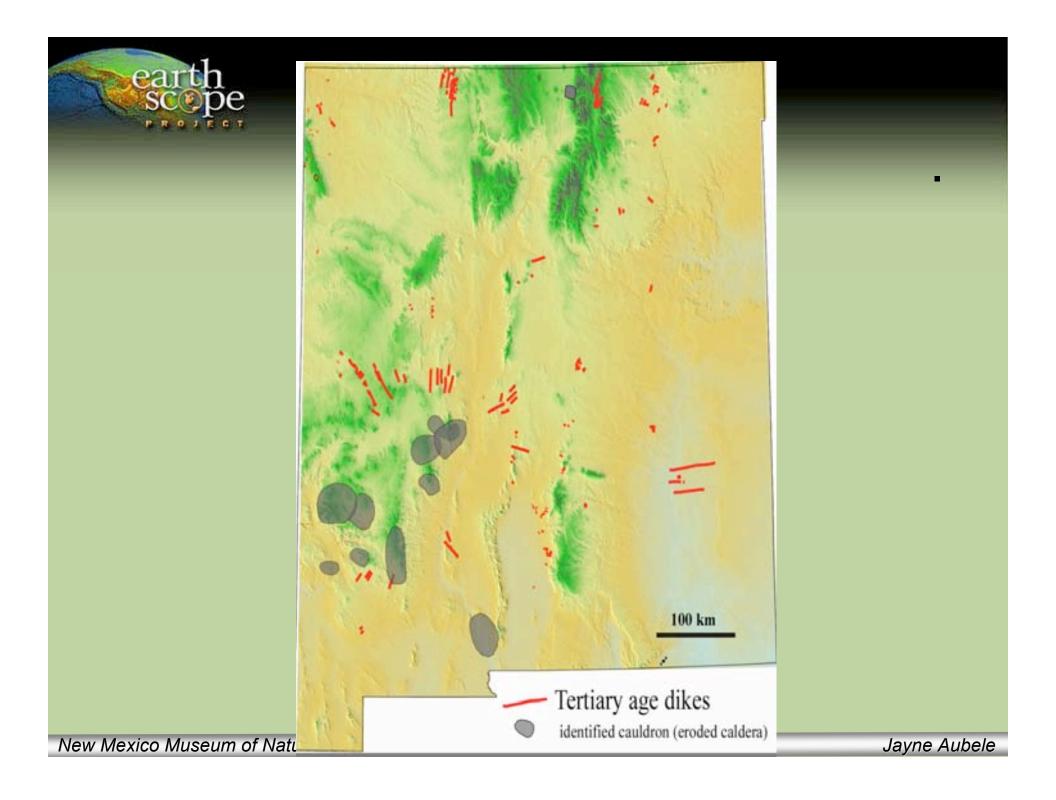
Blackwater Draw / Portales



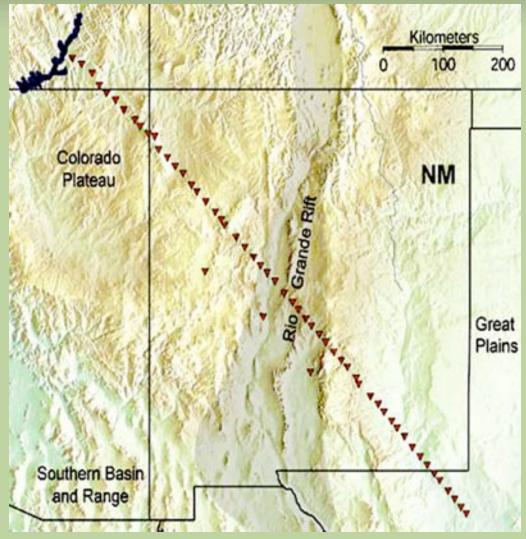
Sinkholes near Roswell and Santa Rosa New Mexico Museum of Natural History and Science



Carlsbad Caverns





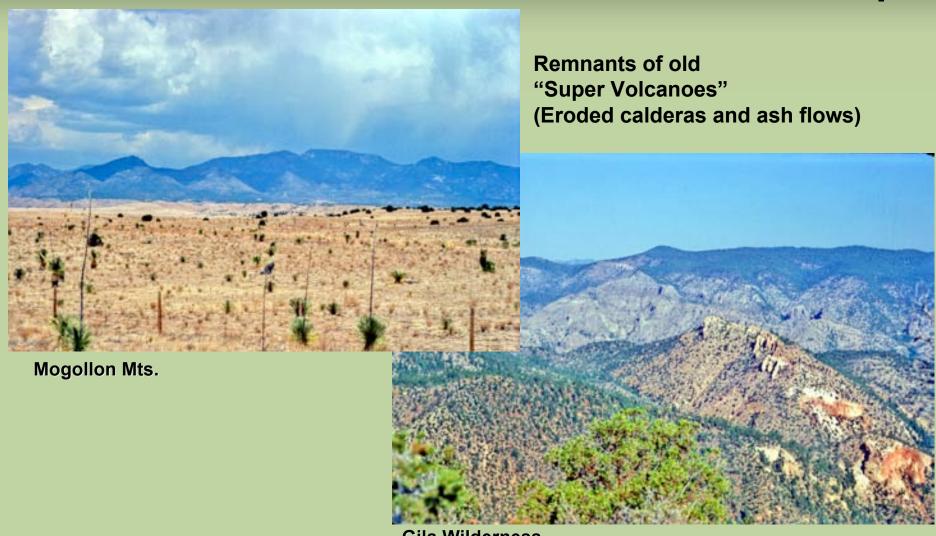




RISTRA Project



Mogollon Highlands (Datil, Black, Burro, Socorro Mts.)







Ash Flow - eroded



Volcanic rocks and hot water

Remnants of old "Super Volcanoes"



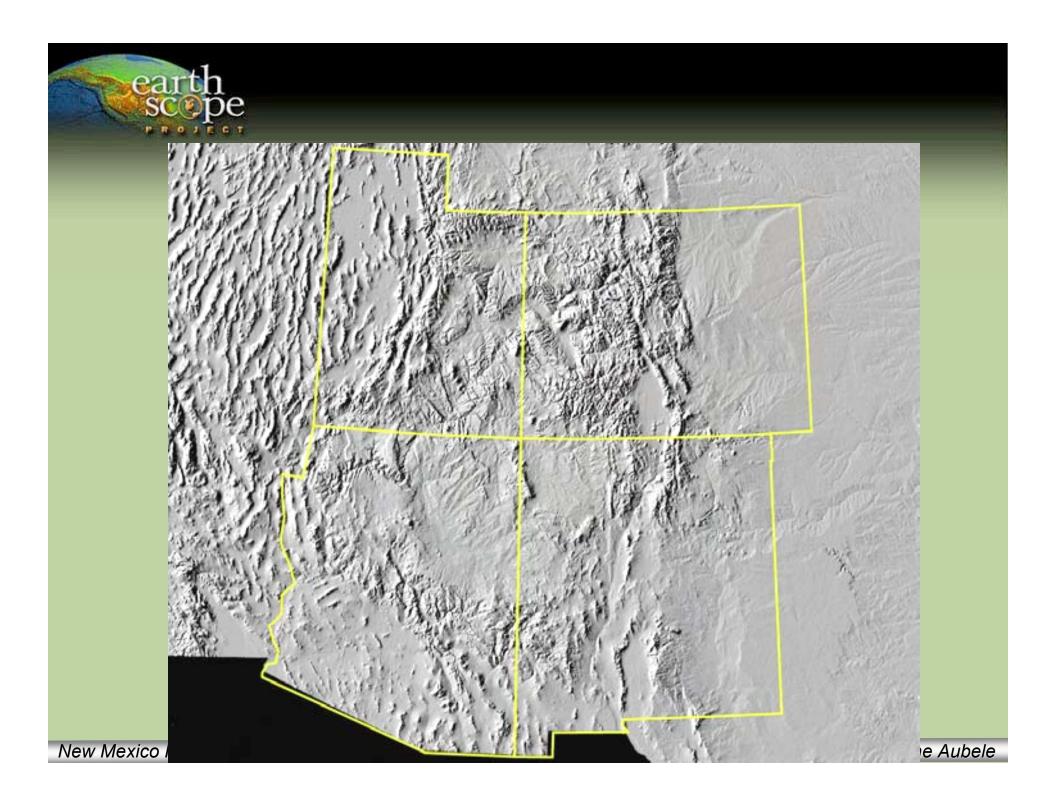
Basin and Range

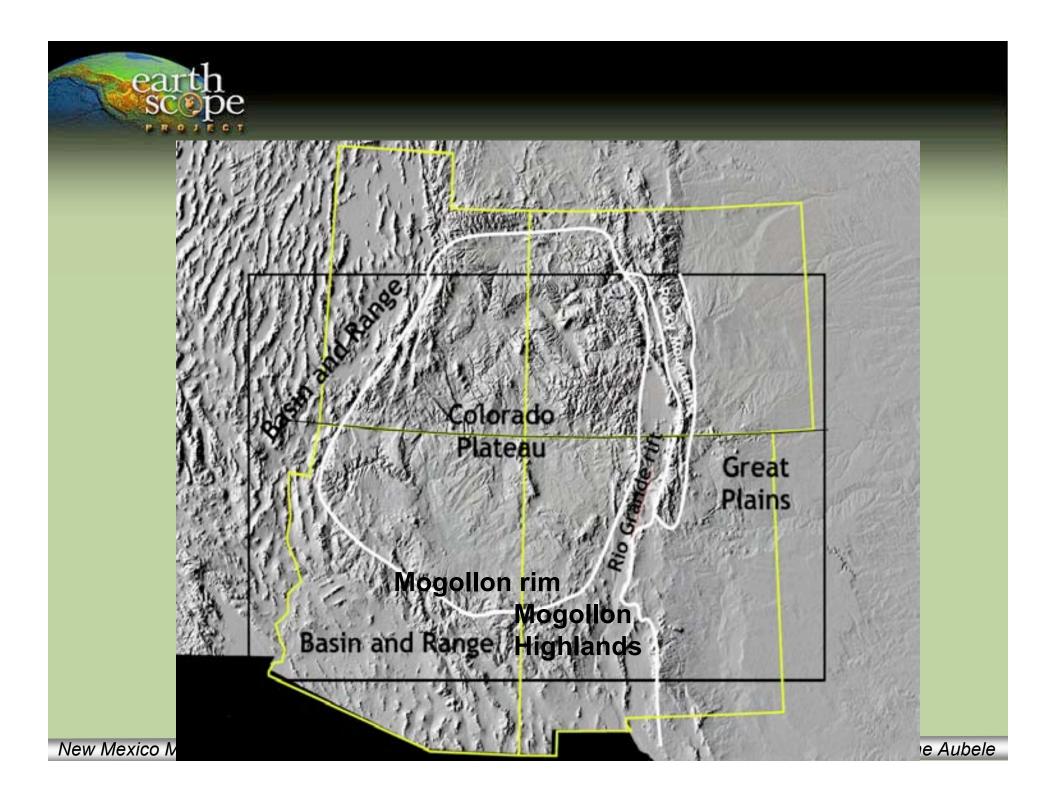
Parallel mountain ranges and valleys All ages/types of rock uplifted Some Tertiary volcanism

Florida Mts



Mimbres Valley







Why EarthScope?



- •The EarthScope experiment exemplifies the insatiable human drive to learn.
- •Encourages a feeling of national interconnectedness a continental sense of place

Major Themes

- •The EarthScope experiment Invites communities to actively participate in the experiment
- •Fosters an understanding that the local environment interacts wth the larger, dynamic Earth system.

