DEATH VALLEY NATIONAL PARK
GEOLOGIC RESOURCES MANAGEMENT ISSUES
SCOPING SUMMARY
(Revised)

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Summary of Death Valley National Park GRI meeting
February 12, 2002

Executive Summary

A Geologic Resources Inventory (GRI) workshop was held for Death Valley National Park (DEVA) on February 12, 2002. The purpose was to view and discuss the park's geologic resources, to address the status of geologic mapping for compiling both paper and digital maps, and to assess resource management issues and needs. Cooperators from the NPS Geologic Resources Division (GRD), DEVA, and the United States Geologic Survey (USGS) were present for the workshop.

The workshop included field trips to various points of interest in DEVA, led by Ren Thompson and Janet Slate of the USGS, as well as another half-day scoping session to present overviews of the NPS Inventory and Monitoring (I&M) program, GRD, and the on-going GRI. Round table discussions involving geologic issues for DEVA included the status of geologic mapping efforts, interpretation, sources of available data, and action items generated from this meeting. A list of meeting attendees may be found in Appendix A (List of Cooperators for Death Valley NP GRI Workshop, February 12, 2002).

The scoping meeting participants identified the following geologic resources management issues:

1. Using a surficial geology layer to correlate across other natural resource themes.

2. Using chlorine-36 to date pebbles in valley fill material providing information as to when the valleys formed and their subsequent tie to fault recurrence

3. Faults in the vicinity of Scotty's Castle need further research due to the potential instability in this culturally rich area.

4. The effects of fluvial processes on development at Zabriskie Point, a high-use area in the park need to be better understood

5. More research is needed on the origin, development and movement of the sand dunes in the Stovepipe Wells area along Highway 190.

6. More research in the Devils Hole quadrangle is needed regarding the habitat of the endangered devils hole pupfish

7. Hydrologic issues at Nevares Peak need further research.

8. The park would like a composite, compiled geologic map of the entire park to sell in the visitor center.

Introduction

The NPS Geologic Resources Inventory has the following goals for some 273 units with significant natural resources:

1) To assemble a bibliography ("GRBIB") of known geological publications to compile and evaluate a list of existing geologic maps for each unit,

2) To conduct a scoping session for each park,
3) To develop digital geologic map products for use in a GIS (Geographic Information System) and,
4) To complete a geologic report that synthesizes much of the existing geologic knowledge about each park.

The purpose of the inventory is not necessarily to initiate new geologic mapping projects, but to compile existing information and to identify the geologic data needs and issues in the National Park System. For those NPS units where map coverage is nearly complete or where maps simply do not exist, funding may be available for geologic mapping.

After introductions by the participants, Bruce Heise (NPS-GRD) presented overviews of the Geologic Resources Division, the NPS I&M Program, the status of the Natural Resource Inventories, and the Geologic Resource Inventory in particular.

Tim Connors (NPS-NRID) presented a demonstration of some of the main features of the digital geologic database for the Black Canyon of the Gunnison NP and Curecanti NRA in Colorado. This has become the prototype for the NPS digital geologic map model as it reproduces all aspects of a paper map (including map notes, cross sections, legend, etc.) with the added benefit of being geospatially referenced. It is displayed in ESRI ArcView shape files and features a built-in Microsoft Windows help file system to identify the map units. It can also display scanned JPG or GIF images of the geologic cross sections supplied with the paper (analog) map. Geologic cross section lines are subsequently digitized as a line coverage and are hyperlinks to the scanned images.

GRBIB

At the scoping session, GRI staff provided geologic bibliographies for DEVA in Microsoft Word format. The sources for information are: (1) The AGI (American Geological Institute) GeoRef; (2) the USGS GeoIndex; and, (3) ProCite information taken from the libraries of specific NPS units. These bibliographic compilations were validated by GRI staff to eliminate duplicate citations, typographical errors, and as well as to check for applicability to the specific park. After validation, they become part of a Microsoft Access database parsed into columns based on park, author, year of publication, title, publisher, publication number, and a miscellaneous column for notes.

For the Access database, they are exported as Microsoft Word Documents for easier readability, and eventually turned into PDF documents. They are then posted to the GRI website at: http://www2.nature.nps.gov/grd/geology/gri/products/geobib/ for general viewing.

Existing Geologic Maps

Prior to 1999, numerous geologic maps by various authors had been completed in the Death Valley region. However, there was never a synthesis of this work to unite it into a composite map of the park. Mel Essington, mining engineer at DEVA, has been a major catalyst in seeing this project become a reality. It has been his desire to have a complete geologic map of the park for many years. His impetus led to a meeting of federal, state, and academic entities that had done geologic work in the Death Valley region.

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In April 1999, a "preliminary" geologic mapping scoping session was held as a sidebar at the Death Valley Symposium in Las Vegas, Nevada. (See "Proceedings of Conference on Status of Geologic Research and Mapping in Death Valley National Park, Las Vegas, Nevada, April 9-11, 1999", USGS Open-File Report 99-153). At this time, several map authors assembled an index of available geologic maps for the Death Valley area. The USGS took the lead in assembling a master database of these maps for their subsequent work in studying the groundwater system of the Nevada Test Site area for their "Halo" map. The NPS-GRI and USGS worked together on funding for the completion of a derivative map for the DEVA area in FY-2000 and FY-2001.

After these bibliographies were assembled, a separate search was made for any existing surficial and bedrock geologic maps for DEVA. The USGS has subsequently released a digital geologic map of the Death Valley region (Workman, *et. al*, 2002). See Appendix D for a glimpse of this completed work.

Larger-scale mapping (>100,000 scale) is known for many areas in the park, especially in the Grape Vine springs area (Scotty's Castle, Bonnie Claire SW quadrangles), but apparently the author is unwilling to release the data.

<u>Additional Needed Geologic Mapping and Research</u>

There are ten 30' x 60' maps that cover the quadrangles of interest to DEVA:

- Pahute Mesa
- Last Chance Range
- Bishop
- Beatty
- Saline Valley
- Death Valley Junction
- Darwin Hills
- Owlshead Mountain
- Ridge Crest
- Soda Mountains

Portions of the park are not included in the recently published MF-2381 by the USGS. Appendix E is a list of the corresponding 7. 5-minute quadrangles that are not included in the new USGS geologic map and thus will need to be filled in at some point either from new mapping or compilation of the existing maps. According to Ren Thompson, Chris Menges (USGS) has maps of the surficial geology for that area that will be compiled and incorporated into a more complete map. Jeremy Workman (USGS) needs to be consulted for additional information regarding filling in these blanks.

Of the (173) 7.5 minute quadrangles of interest, all but 49 (partial and/or whole) are covered on USGS MF-2381 and digital geologic map coverage will need to be developed. It was also suggested to check with the California Division of Mines and Technology to see if they have any existing digital coverage of the area for the interim.

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Physiography

Death Valley National Park lies in the extreme western portion of the Basin and Range physiographic province and also exhibits some of the most extreme relief of the province. The Basin and Range Province is one of the largest and most extensive in the United States. It extends from southeastern Oregon through Nevada and eastern California, southern Arizona, and New Mexico into western Texas. The province is characterized by tilted uplifted fault blocks that form longitudinal, asymmetric mountain ranges separated by broad intervening valleys or basins. The overall structure of these mountain ranges and valleys is generally northwest-southeast.

The western boundary in southern California is the Sierra Nevada crest. The Garlock fault separates the province from the Mojave province to the south (Norris and Web, 1976). In Death Valley NP the northwest-southeast trending ranges include the Panamint, Saline, Last Chance, Cottonwood, Grapevine, Funeral, Greenwater, Black, Amargosa, and Owlshead Mountains and part of the Inyo Range on the northwest boundary. The intervening valleys include Death Valley, Greenwater Valley, Amargosa Valley, Saline Valley, Eureka Valley and part of the Panamint Valley. Relief is dramatic, from the highest point at Telescope Peak (11,049 feet) to the lowest point at Badwater (-282 feet). As with much of the Basin and Range, drainage is internal.

Geologic History

Nearly all major divisions of geologic time are represented in the rock record of this portion of the Basin and Range Province.

Precambrian - The oldest rocks are lower Precambrian (Archean) gneiss, schist and quartzite probably all of sedimentary origin. Some units of this metamorphic basement complex have been dated as 1.8 billion years old (Norris and Webb, 1976). Mafic to felsic granitic rocks were also emplaced during the Archean Era. Following emplacement of the basement complex, there was a long interval of uplift. The surface of the region was above sea level and deeply eroded.

In the late Precambrian, downwarping resulted in the land surface of the region subsiding below sea level (Wright, *et. al*., 1953). A shallow sea transgressed across the region and deposited up to 6,000 feet of sediments. These shallow marine deposits of conglomerate, sandstone, shale, limestone, and dolomite represent the earliest deposits of the Cordilleran geosyncline and are known as the Pahrump Group (Norris and Webb, 1976). The pattern of the late Precambrian to Cambrian sediments suggests that the depositional environment was a well defined, north-northwest striking trough, tributary to the main Cordilleran geosyncline. The axis of this ancient trough roughly coincides with the present-day topographic depression formed by southern Death Valley and the Amargosa Valley (Wright and Troxel, 1965; Roberts, 1974). Large diabase sills were intruded into the lower portion of these geosynclinal sediments. Diabase emplacement is thought to have been prior to lithification of the sediments, and probably before deposition of the upper half of the Pahrump Group deposits (Wright, *et. al*., 1953). Downwarping and deposition in a shallow sea (less than 100 feet deep) continued through the end of the Precambrian.

Paleozoic Era - By the beginning of the Paleozoic, the subsidence had developed into a huge, north-northwest trending trough across western North America (the Cordilleran Geosyncline). The Cordilleran Geosyncline persisted through the Paleozoic and into the Mesozoic with several transgressions and regressions of the shallow sea. The region accumulated large volumes of nearshore and offshore marine sediments during this era with up to 23,000 feet attributed to the Cambrian and Ordovician periods, and over 7,000 feet in the Silurian and Devonian (Nolan, 1943). By the end of the Devonian, uplift resulted in only a few Carboniferous and Permian Period deposits. The uplift persisted through the Permian into the Mesozoic and eventually assisted in the disappearance of the geosynclinal seas that had covered the region through much of the Paleozoic.

Mesozoic Era - A series of compressional pulses affected the west coast between mid-Jurassic and Cretaceous time. Initiated by converging tectonic plates, this compression produced uplift of the region and caused folding and faulting of both Precambrian and Paleozoic strata. This episode of compressional mountain building is known as the Nevadan orogeny. At the height of the Nevadan orogeny, the base of the geosynclinal sediments were transformed into molten rock and emplaced as batholiths. These igneous rocks are now unroofed and form the Sierra Nevada batholith and other Mesozoic intrusives throughout the region (Clark, 1960).

Cenozoic Era - The early Cenozoic (Paleocene, Eocene and Oligocene epochs) is present only as igneous intrusions and cemented stream gravels. During this time, the region was probably above sea level, exhibited low relief, and was eroded with little deposition. Crustal compression related to the Nevadan orogeny and associated with the Laramide orogeny continued to affect the region until the Eocene. By mid-Cenozoic, compressional forces had ceased and by the Miocene, extensional forces began to affect the region, probably caused by the North American continental plate overriding the Gulf of California spreading center. Crustal tension resulted in the basin and range topography created by normal faulting, down-dropped grabens, and uplifted horst block ranges which are elongated north-south, perpendicular to the primary direction of extension. Thick, non-marine basin deposits were formed reminiscent of those being formed today. Associated saline, borate, and shallow lake deposits indicate an arid to semi-arid climate. These conditions have persisted through the late Tertiary into Recent geologic time.

Stratigraphy

Metamorphic and Crystalline Basement Complex - Basement rocks of the region are a complex of Archean schists and mostly gray, granitic to dioritic gneisses, probably of sedimentary origin, and intrusive granitic rocks (Norris and Webb, 1976). Also included in the complex are subordinate quartzite, mica schist, migmatite, amphibolite, marble and intrusive granitics. The metamorphism of the schist has been dated in the south Panamint Range as 1,700 million years (MY) by potassium/argon dating and 1480 MY by rubidium/strontium methods (Wasserburg, *et. al*., 1959; Hunt and Mabey, 1966). These rocks crop out in the Black Mountains, Ibex Hills, Panamint Range, Greenwater Range, Nopah Range and the Alexander Hills (Noble and Wright, 1954).

Later Precambrian Rocks – Unconformably overlying the Archean Basement Complex is a series of unmetamorphosed, or slightly metamorphosed sedimentary rocks that make up the late Precambrian Pahrump Series. The Pahrump Series extends over a 75 mile by 25 mile (121 km by 40 km) area and is divided into three formations as described by Hewett (1940): the Crystal Spring Formation, the Beck Spring Formation, and the Kingston Peak Formation.

Crystal Spring Formation - Unconformably overlying the basement rock is the Crystal Spring Formation. This formation is generally 3,000 to 4,200 feet thick and consists of a lower clastic unit (200-2,000 feet thick), a middle carbonate unit (200-1,300 feet thick), and an upper carbonate and clastic unit (200-1200 feet thick) (Hewett, 1940; Wright, *et. al.*, 1953; Wright, 1968; Noble and Wright, 1954).

Diabase (2 - 1,500 feet thick) – In the southern part of DEVA, diabase has intruded the Crystal Springs Formation primarily in sills. These occur mostly at the base of, within, or immediately above the carbonate member of the Crystal Spring Formation. Numerous feeder dikes cut the lower member. The sill present at the base of the carbonate member is persistent and extensive and is thought to have originally underlain the entire area. Known as the Ibex Sill, it exists at this stratigraphic contact almost everywhere the Crystal Spring Formation is found. It is a dark green to greenish-black igneous rock, commonly aphanitic but occasionally porphyritic with phenocrysts of plagioclase and pyroxene. Where the diabase contacts the carbonate there are deposits of talc which have been extensively mined in the past.

Beck Spring Formation - Conformably overlying the Crystal Spring Formation is the middle formation of the Pahrump Group, the Beck Spring dolomite. It is a bluish-gray cherty dolomite about 1,000 feet thick containing 30% CaO and 20% MgO (Hunt and Mabey, 1966).

Kingston Peak Formation - The Kingston Peak Formation is about 1000 to 3000 feet thick and conformably overlies the Beck Spring Formation. It is the upper formation of the Pahrump Group. It is made up of conglomeratic greywacke, quartzite, conglomeratic quartzite, limestone, dolomite, sandstone and shale. The formation contains abundant detritus from the lower two Pahrump Group formations (Noble and Wright, 1954).

Noonday Dolomite - This formation crops out in the southern Panamint Range on the west side of DEVA. Thickness varies from 800 feet to 1,000 feet. It is composed of tan to gray dolomite with increasing tan to white limestone and limestone conglomerate to the north (Hunt, 1975).

Johnnie Formation - Consists of interbedded purple shale and quartzite underlain by by massive beds of dolomite, yellow shale, and, in the lower part, interbedded sandstone, quartzite, and dolomite. The basal member is 400 feet thick. Total thickness is about 4,000 feet.

Stirling Quartzite - Cross-bedded quartzite with a 500-foot purple shale bed; total thickness is about 2,000 feet.

Paleozoic Rocks – All the periods of the Paleozoic are represented in the Death Valley region; total thickness of the Paleozoic section:16,945'+ (Hunt, 1975)

Cambrian: Wood Canyon Formation (quartzite, shale and dolomite), Zabriskie Quartzite, Carrara Formation (shale, siltstone, limestone), Bonanza King Formation (massive dolomite; thin bedded limestone), and Nopah Formation (basal fossiliferous shale; dolomite); total thickness: 6,900'-8200'

Ordovician: Pogonip Group (mostly dolomite; shale in middle), Eureka Quartzite, and Ely Springs Dolomite (massive, black); total thickness: 2250'-2650'
Silurian/Lower Devonian: Hidden Valley Dolomite; thickness: 300'-1,400'
Devonian: Lost Burro Formation (mostly limestone with beds of quartzite and sandstone); thickness ~2,000'
Mississippian: Tin Mountain Limestone (including unnamed limestone unit); total thickness: 1,725'
Mississippian/Pennsylvanian: Rest Spring Shale; thickness: 750'
Pennsylvanian/Permian: Formations at east foot of Tucki Mountain (conglomerate, limestone, shale; thickness: 3,000'+

Mesozoic Rocks – Exposures of Mesozoic sedimentary and volcanic rocks are not extensive in the region. Only the Triassic is present in DEVA. Sedimentary rocks are both marine and non-marine. Late Mesozoic granitic rocks, associated with emplacement of the Sierra Nevada Batholith, are widespread and abundant in the region.

Triassic: Butte Valley Formation (metasediments and volcanics); thickness: 8,000' (Hunt, 1975)

Cenozoic Rocks – Both the Tertiary and Quaternary periods are present and all epochs are represented. Tertiary volcanic and non-marine sedimentary rocks are widely represented in the region. Regionally the volcanics range in composition from rhyolite to basalt. Tertiary basins accumulated as much as 10,000 feet of sediments. These sediments were sandstone, shale, and tuff with interbedded saline deposits such as borates, gypsum, salt, celestite ($SrSO_4$), and strontianite ($SrCO_3$). Tertiary marine sediments are much more limited in extent. In the Quaternary large volumes of material continued to erode from uplifted horst block ranges, forming vast alluvial and colluvial deposits. Strata can contain saline deposits. Some volcanism persisted into Recent time; however, the region has been inactive during historic time. Total thickness: 16,000'+

Tertiary:
- Paleocene and Eocene: Granitic intrusions and volcanics (Hunt, 1975)
- Oligocene: Titus Canyon Formation (cemented stream gravels); thickness:3,000'
- Miocene: Artist Drive Formation (cemented gravels and playa deposits); thickness: 5,000'
- Pliocene: Furnace Creek Formation (cemented gravels and playa deposits); source of Death Valley borate deposits; Funeral Formation (cemented fan gravels) total thickness: 6,000'+

Quaternary:
- Pleistocene: Alluvial fan and playa deposits; thickness: ~2,000'
- Holocene: Alluvial fan and playa deposits; thickness: <100'

Significant Geologic Resource Management Issues in Death Valley National Park

1. Mapping

There is an identified need by Linda Greene, Chief of Natural Resources at DEVA to use surficial geology mapping as a GIS geology layer and correlating it with other natural resource themes such as vegetation, archaeology, and mining. For example, sediment derived from the Bonanza King dolomite unit has a distinct correlation with the occurrence and distribution of major piñon juniper forests.

2. Research

- Janet Slate with the U.S. Geological Survey has been using chlorine-36 to date pebbles in valley fill material providing information as to when the valleys formed and their subsequent tie to fault recurrence.

- The fault's in the Scotty's Castle area need to be better researched because of the potential for instability in this cultural resource-rich area.

- Sand dunes in the Stovepipe Wells area along Highway 190 need more research on their origins and development and movement history.

- The Devils Hole quadrangle could use more research because of the tie to the endangered Devils Hole pupfish.

- Nevares Peak is in need of research of hydrological issues.

- Zabriskie Point is a high-use area in the park that is often affected by the fluvial system; it's effects for further development in this area need to be better understood

3. Interpretation

The park would like to have a composite geologic map compiled for the entire park to sell in the visitor’s center. Ren Thompson thought it would probably take about two more years to develop such a product for the park. It was also brought out in the scoping session that the park resource managers are interested in using the geologic maps for various interpretive examples throughout the park

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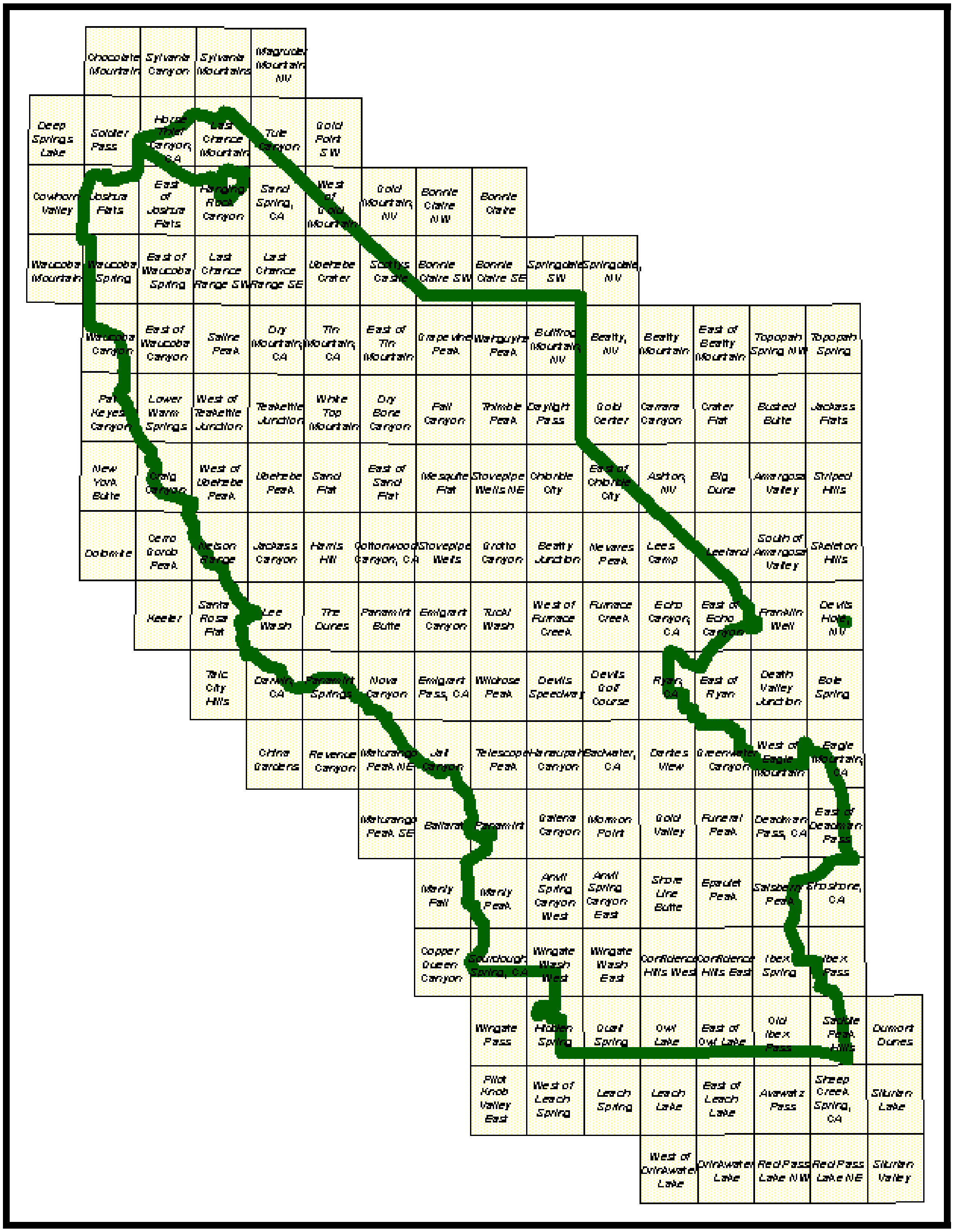
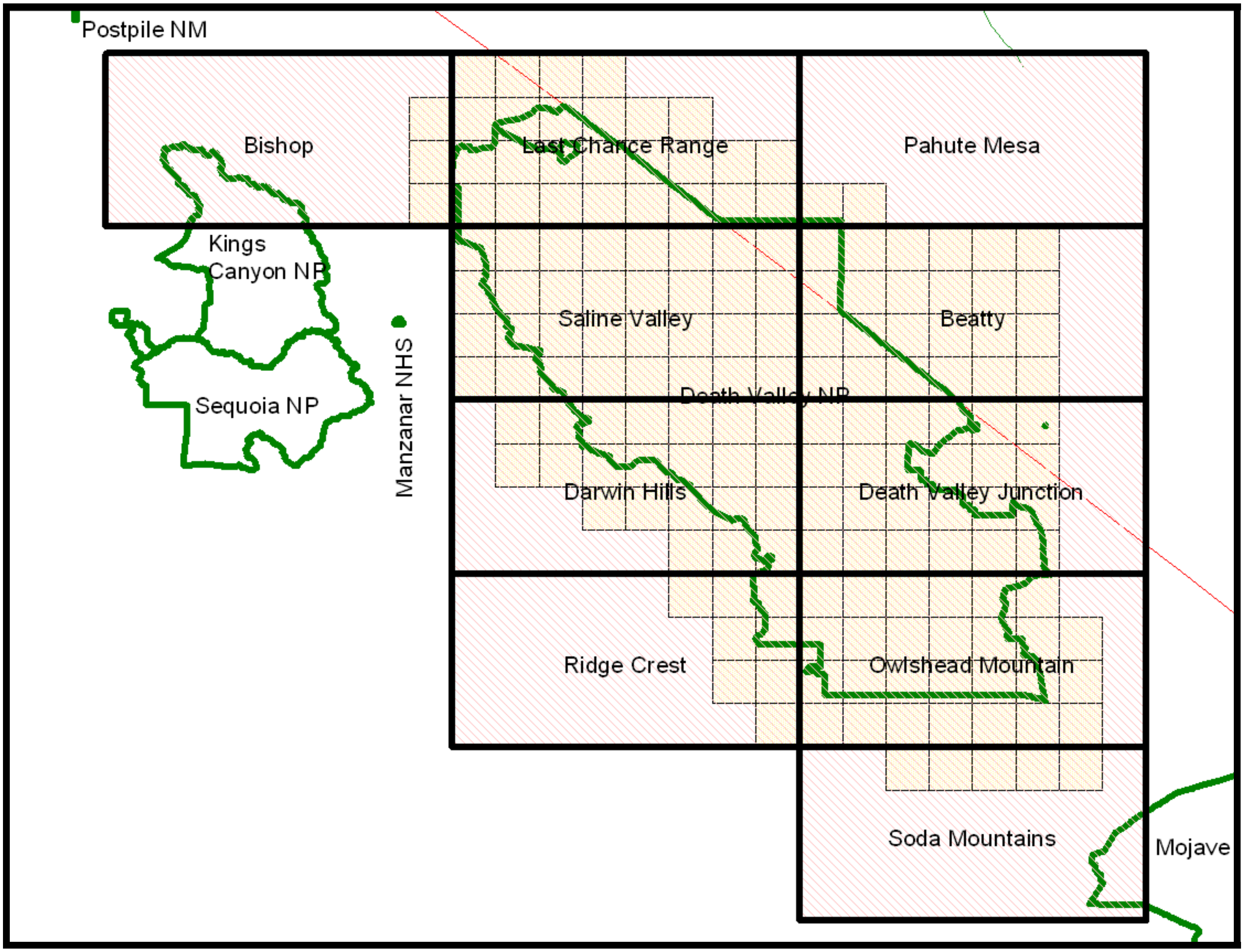
Appendix A: List of Cooperators for Death Valley NP GRI Workshop
February 12, 2002

LAST NAME	FIRST NAME	TYPE	AFFILIATION	TITLE	PHONE	E-MAIL	Field Trip	Scoping Session
Anderson	Dick	Federal	NPS, DEVA		760-786-3251	richard_l_anderson@nps.gov	no	yes
Baldino	Terry	Federal	NPS, DEVA		760-786-3279	terry_baldino@nps.gov	no	yes
Baldino	Cristi	Federal	NPS, DEVA		760-786-3266	cristi_baldino@nps.gov	no	yes
Christensen	Jon	Federal	NPS, DEVA		760-786-3262	jon_christensen@nps.gov	no	yes
Connors	Tim	Federal	NPS, Geologic Resources Division	Geologist	(303) 969-2093	Tim_Connors@nps.gov	yes	yes
Derobertis	Ed	Federal	NPS, DEVA		760-786-3294	ed_derobertis@nps.gov	no	yes
Essington	Mel	Federal	NPS, DEVA	mining engineer	760-786-3257	mel_essington@nps.gov	no	yes
Fisk	Terry	Federal	NPS, DEVA		760-786-3255	terry_fisk@nps.gov	no	yes
Greene	Linda	Federal	NPS, DEVA	natural resources	760-786-3253	linda_greene@nps.gov	no	yes
Heise	Bruce	Federal	NPS, Geologic Resources Division	geologist	(303) 969-2017	Bruce_Heise@nps.gov	yes	yes
Hendrickson	Lynn	Federal	NPS, DEVA		760-786-3294	lynn_hendrickson@nps.gov	no	yes
Manning	Linda	Federal	NPS, DEVA		760-786-3252	linda_manning@nps.gov	no	yes
Moran	Toni	Federal	NPS, DEVA		760-786-3269	toni_moran@nps.gov	no	yes
O'Dea	Marian	Federal	NPS, DEVA		760-786-3278	marian_o'dea@nps.gov	no	yes
Reynolds	J.T.	Federal	NPS, DEVA	Superintendent	760-786-3243	jt_reynolds@nps.gov	no	yes
Roche	Jim	Federal	NPS, DEVA	geologist	760-786-3250	jim_roche@nps.gov	no	yes
Rondthaler	Jane	Federal	NPS, DEVA	VIP		j_rondy@hotmail.com	no	yes
Slate	Janet	Federal	USGS	geologist	303-236-1284	jslate@usgs.gov	yes	yes
Stark	John	Federal	NPS, DEVA	GIS	760-786-3254	john_stark@nps.gov	no	yes
Taylor	Ryan	Federal	NPS, DEVA		760-786-3238	ryan_taylor@nps.gov	no	yes
Thompson	Ren	Federal	USGS	geologist	303-236-0929	rathomps@usgs.gov	yes	yes
Wolfe	Gerry	Federal	NPS, DEVA		760-786-3219	gerry_wolfe@nps.gov	no	yes
Workman	Jeremy	Federal	USGS		303-236-1257	Jworkman@usgs.gov	No	no
York	Dana	Federal	NPS, DEVA		760-786-3233	dana_york@nps.gov	no	yes

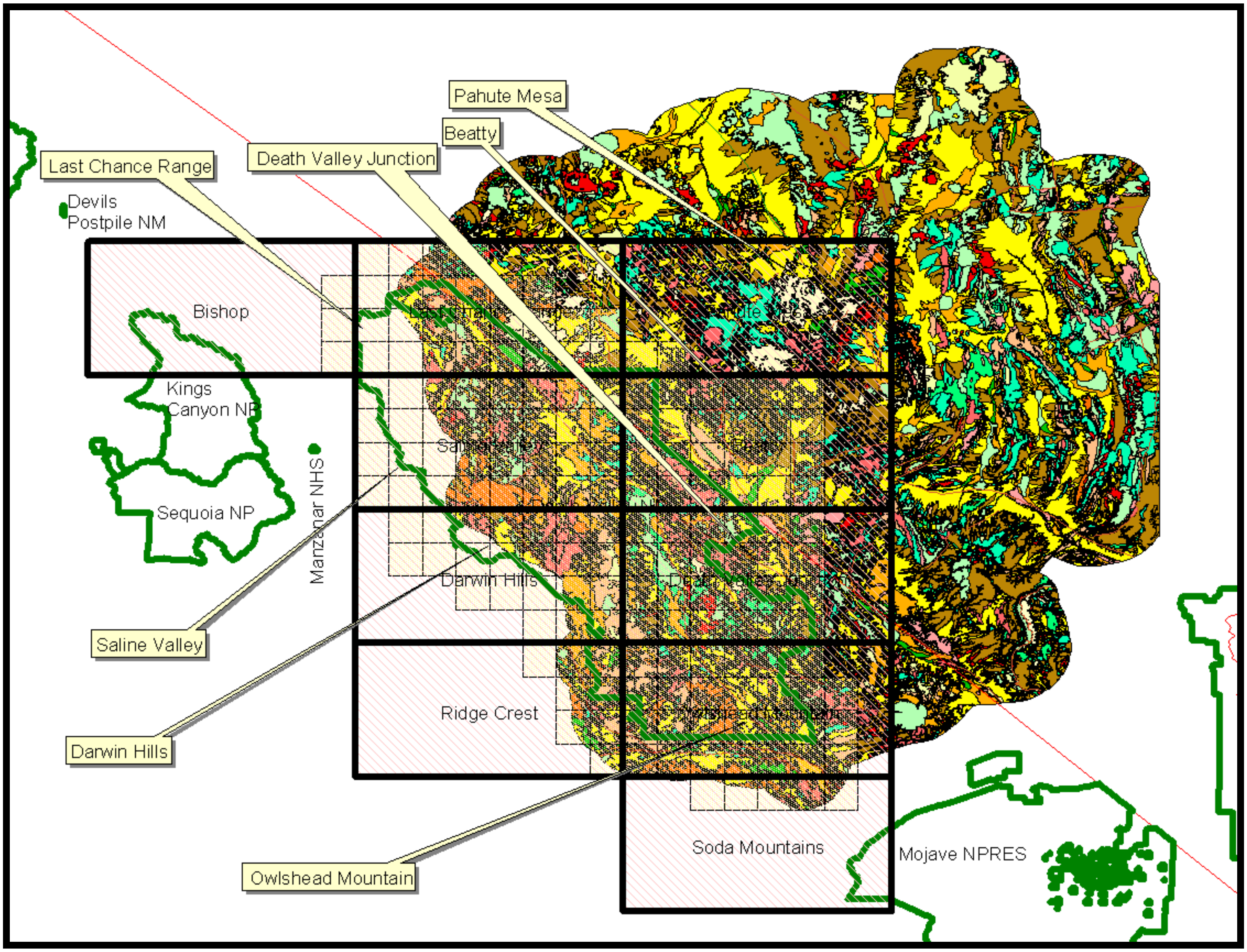
Appendix B: USGS 7.5' Quadrangles of Interest for DEVA



Appendix C: USGS 30' x 60', and 7.5' Quadrangles of Interest for DEVA



Appendix D: USGS MF-2351 Digital Geology for DEVA superposed on DEVA quadrangles of interest



Appendix E: DEVA 7.5' quadrangles of interest not covered by USGS MF-2351 Digital Geology and still needed from USGS

USGS_NAME	State	Minimum Longitude	Minimum Latitude	Maximum Latitude	Minimum Longitude	30 x 60 sheet
Sylvania Mountains	NV	37.375	-117.625	37.5	-117.75	Last Chance Range
Sylvania Canyon	CA	37.375	-117.75	37.5	-117.875	Last Chance Range
Chocolate Mountain	CA	37.375	-117.875	37.5	-118	Last Chance Range
Horse Thief Canyon	CA	37.25	-117.75	37.375	-117.875	Last Chance Range
Soldier Pass	CA	37.25	-117.875	37.375	-118	Last Chance Range
Deep Springs Lake	CA	37.25	-118	37.375	-118.125	Bishop
East of Joshua Flats	CA	37.125	-117.75	37.25	-117.875	Last Chance Range
Joshua Flats	CA	37.125	-117.875	37.25	-118	Last Chance Range
Cowhorn Valley	CA	37.125	-118	37.25	-118.125	Bishop
East of Waucoba Canyon	CA	37	-117.75	37.125	-117.875	Saline Valley
Waucoba Mountain	CA	37	-118	37.125	-118.125	Bishop
East of Waucoba Spring	CA	36.875	-117.75	37	-117.875	Last Chance Range
Waucoba Canyon	CA	36.875	-117.875	37	-118	Saline Valley
West of Teakettle Junction	CA	36.75	-117.625	36.875	-117.75	Saline Valley
Lower Warm Springs	CA	36.75	-117.75	36.875	-117.875	Saline Valley
Pat Keyes Canyon	CA	36.75	-117.875	36.875	-118	Saline Valley
Ubehebe Peak	CA	36.625	-117.5	36.75	-117.625	Saline Valley
West of Ubehebe Peak	CA	36.625	-117.625	36.75	-117.75	Saline Valley
Craig Canyon	CA	36.625	-117.75	36.75	-117.875	Saline Valley
New York Butte	CA	36.625	-117.875	36.75	-118	Saline Valley
Nelson Range	CA	36.5	-117.625	36.625	-117.75	Saline Valley
Dolomite	CA	36.5	-117.75	36.625	-117.875	Saline Valley
Waucoba Spring	CA	36.5	-117.875	36.625	-118	Last Chance Range
Cerro Gordo Peak	CA	36.5	-117.875	36.625	-118	Saline Valley
The Dunes	CA	36.375	-117.375	36.5	-117.5	Darwin Hills
Lee Wash	CA	36.375	-117.5	36.5	-117.625	Darwin Hills
Santa Rosa Flat	CA	36.375	-117.625	36.5	-117.75	Darwin Hills
Keeler	CA	36.375	-117.75	36.5	-117.875	Darwin Hills
Nova Canyon	CA	36.25	-117.25	36.375	-117.375	Darwin Hills
Panamint Springs	CA	36.25	-117.375	36.375	-117.5	Darwin Hills
Darwin	CA	36.25	-117.5	36.375	-117.625	Darwin Hills
Talc City Hills	CA	36.25	-117.625	36.375	-117.75	Darwin Hills
Jail Canyon	CA	36.125	-117.125	36.25	-117.25	Darwin Hills
Maturango Peak NE	CA	36.125	-117.25	36.25	-117.375	Darwin Hills
Centennial Canyon	CA	36.125	-117.375	36.25	-117.5	Darwin Hills
Revenue Canyon	CA	36.125	-117.375	36.25	-117.5	Darwin Hills
China Gardens	CA	36.125	-117.5	36.25	-117.625	Darwin Hills
Ballarat	CA	36	-117.125	36.125	-117.25	Darwin Hills
Maturango Peak SE	CA	36	-117.25	36.125	-117.375	Darwin Hills
Copper Queen Canyon	CA	35.75	-117.125	35.875	-117.25	Ridge Crest
Silurian Lake	CA	35.5	-116.125	35.625	-116.25	Owlshead Mountain
Pilot Knob Valley East	CA	35.5	-117	35.625	-117.125	Ridge Crest
Slate Range Crossing	CA	35.5	-117.125	35.625	-117.25	Ridge Crest
Silurian Valley	CA	35.375	-116.125	35.5	-116.25	Soda Mountains
Red Pass Lake NE	CA	35.375	-116.25	35.5	-116.375	Soda Mountains
Red Pass Lake NW	CA	35.375	-116.375	35.5	-116.5	Soda Mountains
Drinkwater Lake	CA	35.375	-116.5	35.5	-116.625	Soda Mountains
West of Drinkwater Lake	CA	35.375	-116.625	35.5	-116.75	Soda Mountains
Layton Spring	CA	35.375	-117.875	35.5	-118	Ridge Crest