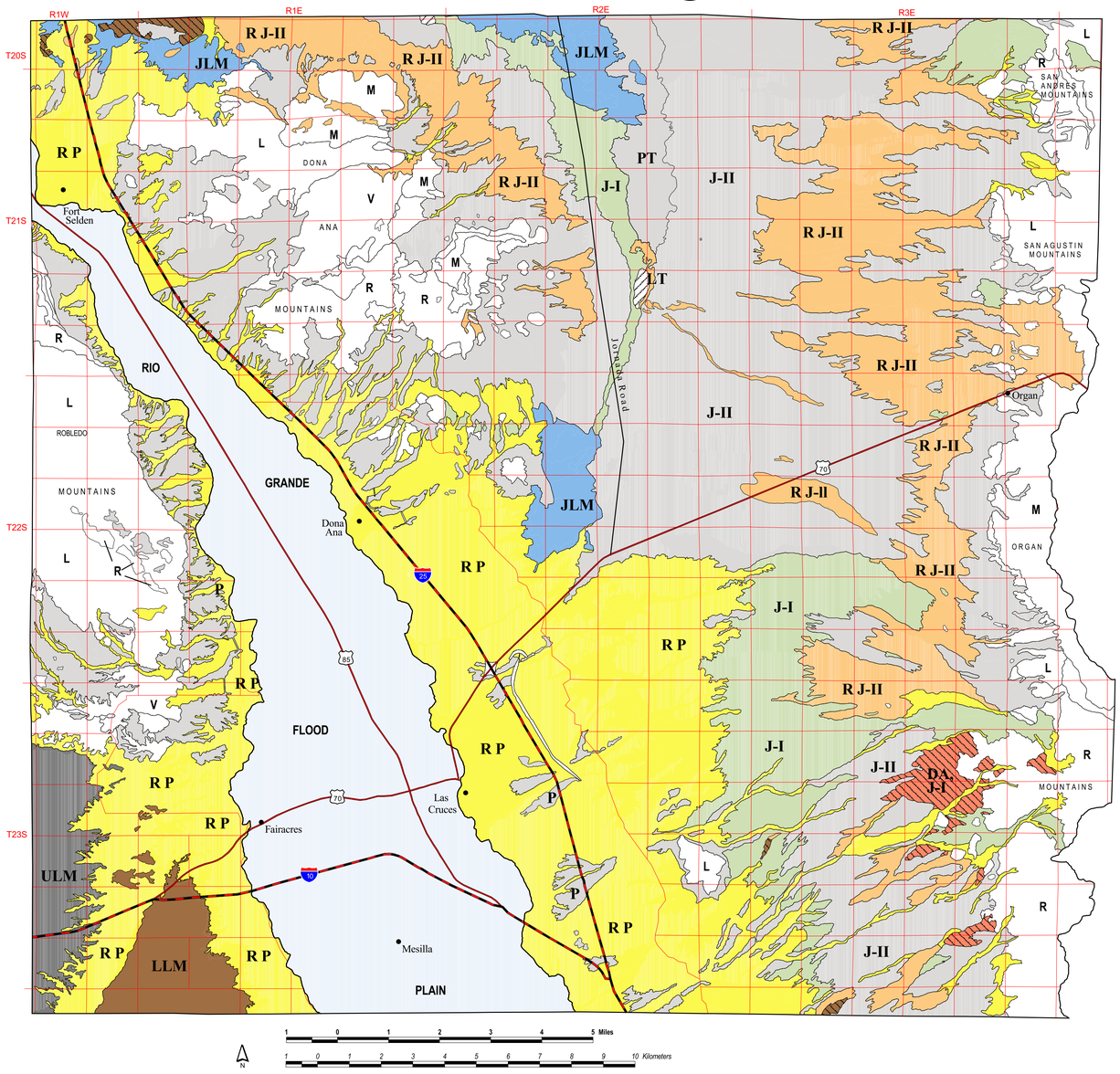
SHEET 5

SOIL-GEOMORPHIC RECONSTRUCTION: THE SOIL CHRONOLOGY, ARGILLIC HORIZON, AND STAGES OF CARBONATE ACCUMULATION AT THE END OF THE LAST PLEISTOCENE FULL-GLACIAL, 17,000 YEARS AGO

As in many arid regions, buried soils are extensive in the Desert Project. Long exposures of land-surface and buried soils in gullies and in dissected terrains, together with detailed studies in trenches, have been used in the soil-geomorphic reconstructions that follow.

The Soil Chronology 17,000 Years Ago



GEOMORPHIC SURFACES AND SOIL AGE

Geomorphic Surface: Valley border	Piedmont slope	Basin floor	Estimated Soil Age (years B.P. or epoch)
		Lake Tank (LT)	17,000 - 150,000
Late Picacho	Late Jornada II		Late Pleistocene (17,000 - 75,000)
Picacho (P)	Jornada II (J-II)	Petts Tank (PT)	Late Pleistocene (75,000 -150,000)
Tortugas (included in P and J-I)			Late to middle Pleistocene (150,000 - 250,000)
Jornada (J-I)	Jornada I (J-I)	Jornada I (J-I)	Late middle Pleistocene (250,000 - 400,000)
	Dona Ana (DA)		(>400,000)
Buried surfaces and soils			Middle Pleistocene (400,000 - 780,000)
Lower La Mesa (LLM)			Middle to early Pleistocene (780,000)
JER La Mesa (JLM)			Early Pleistocene to late Pliocene (780,000 - 2,000,000)
Upper La Mesa (ULM)			Late Pliocene (2,000,000 - 2,500,000)

MAP UNITS WITH MORE THAN ONE MAJOR AGE

- DA and J-I
- J-II, J-I, and La Mesa undifferentiated

RECONSTRUCTED SURFACES AND SOILS AT THE END OF THE FULL-GLACIAL

- Late Pleistocene (mostly Jornada II): 17,000 - 150,000 years old (R J-II)
- Pleistocene undifferentiated: soils and sediments 17,000 - 1,800,000 years old (R P)

Letters in parentheses are map symbols

Bedrock Areas

L	Sedimentary
M	Intermediate Intrusive
R	Rhyolite
V	Volcanic (undiff.)

Includes areas of soils classified at the great group level and above. Small bedrock areas not designated (see detailed map in Volume III).

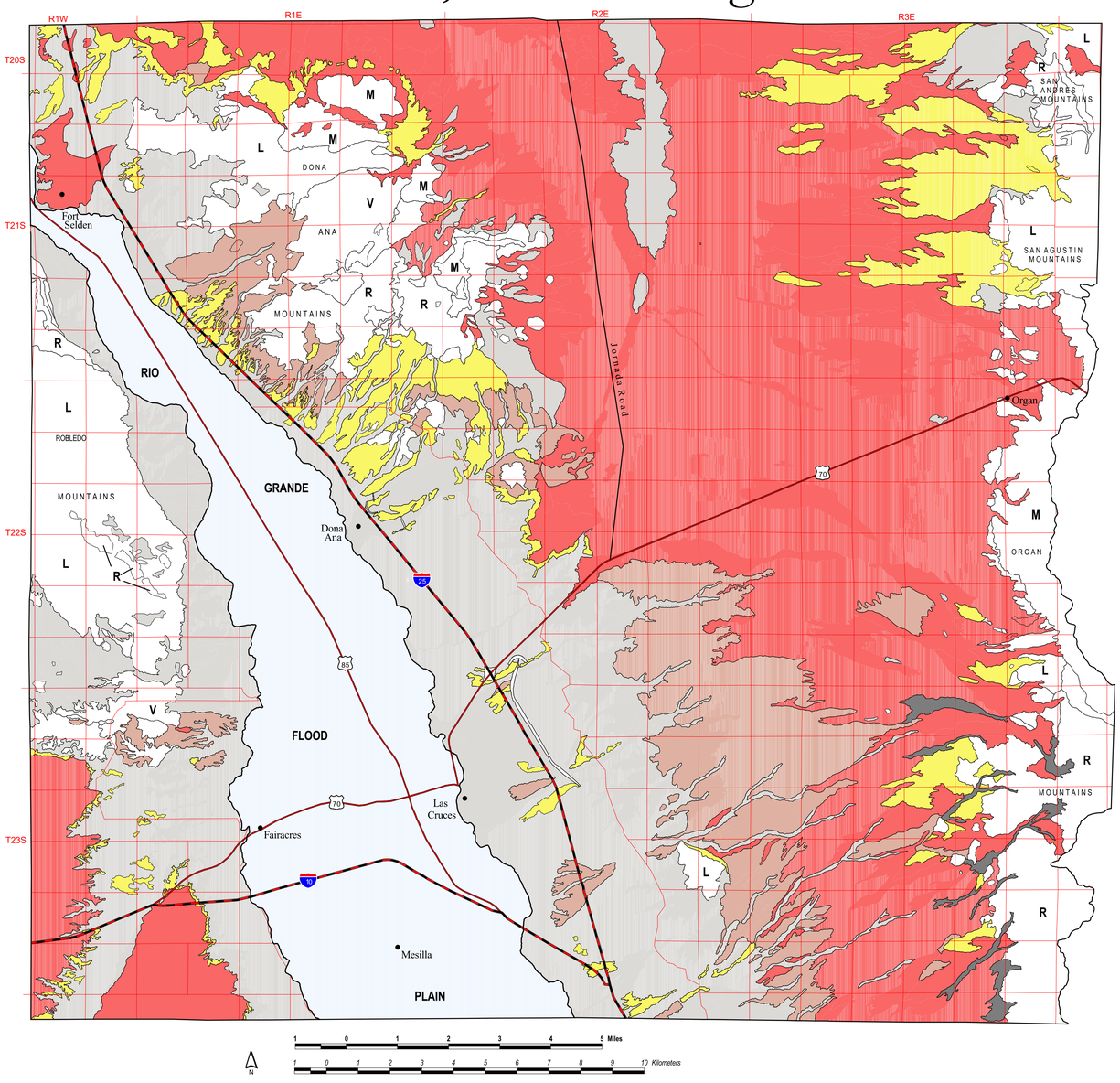
Ages given are dominant for the map unit. Geomorphic surfaces are indicated at illustrative sites only. Jornada I and II include younger surfaces. The late phases of Jornada II and Picacho are relatively minor in extent and have not been separately mapped. They are included here because they occupy a highly significant part of the soil chronology. The Tortugas surface, not shown separately on this map, is included in some areas of the Picacho and Jornada I surfaces along the valley border. Buried surfaces and soils refer to surfaces and soils that are stratigraphically between the Jornada I soil and alluvium of the ancestral Rio Grande, north and south of Tortugas Mountain. Jornada I and La Mesa surfaces are not formally considered a part of the valley border but are included here because they form part of a stepped sequence with the valley border surfaces.

As shown on the present chronology map, extensive areas of late Pleistocene soils and surfaces already exist at the land surface. On the piedmont slope, the reconstruction map has commonly been made by connecting these surficial late Pleistocene soils of J-II age with the late Pleistocene soils that have been buried by deposits since the last full-glacial. In these places there is generally enough evidence to estimate a dominant late Pleistocene age for those buried soils, indicated on the map by the designation R J-II, for the reconstructed J-II surface and soils. In other cases, such as near the mountain canyons, there is less certainty about the age of sediments and soils that have been buried by deposits since the full-glacial. Such areas are designated Pleistocene, indicated on the reconstruction map by R P.

In some areas of the piedmont slope there is complex occurrence of post-full-glacial and older deposits. This is particularly the case below the Dona Ana Mountains, where the contributing watershed is relatively small as compared to the San Andres and Organ Mountains. In the present chronology, these complex patterns are indicated by diagonal pattern below the Dona Ana Mountains. In contrast to most of the piedmont slope, where soil burial is common, along the valley border the late and middle Pleistocene surfaces and soils have been cut in many places by arroyos that descend to the Rio Grande flood plain, and erosion surfaces are common. After deposits since the full-glacial have been removed, these areas are designated Pleistocene, indicated on the reconstruction map by R P.

In addition to the relatively thick (one to several meters) post-full-glacial deposits shown on the present chronology map, there are also thin (less than ½ meter) deposits, not shown, that overlie the older deposits in a number of places. These thin deposits are generally not readily apparent at first glance because of similarities in landscape and soil texture, but have been observed in detailed studies. Thus the overall impact of post-full-glacial deposits on soils presently at the land surface has been substantial, and nearly all soils have been affected to some degree. Finer-textured soils of the basin floors show little evidence of sedimentation since the full-glacial, and probably have been affected least by these younger sediments.

The Argillic Horizon 17,000 Years Ago



OCCURRENCE OF THE ARGILLIC HORIZON, 17,000 YEARS AGO

- Most soils have an argillic horizon (89,621 - 49)
- Some (5-50%) soils have an argillic horizon (18,327 - 10)
- Very few (<5%) soils have an argillic horizon (16,070 - 9)
- No soils have an argillic horizon (58,768 - 32)
- Undifferentiated

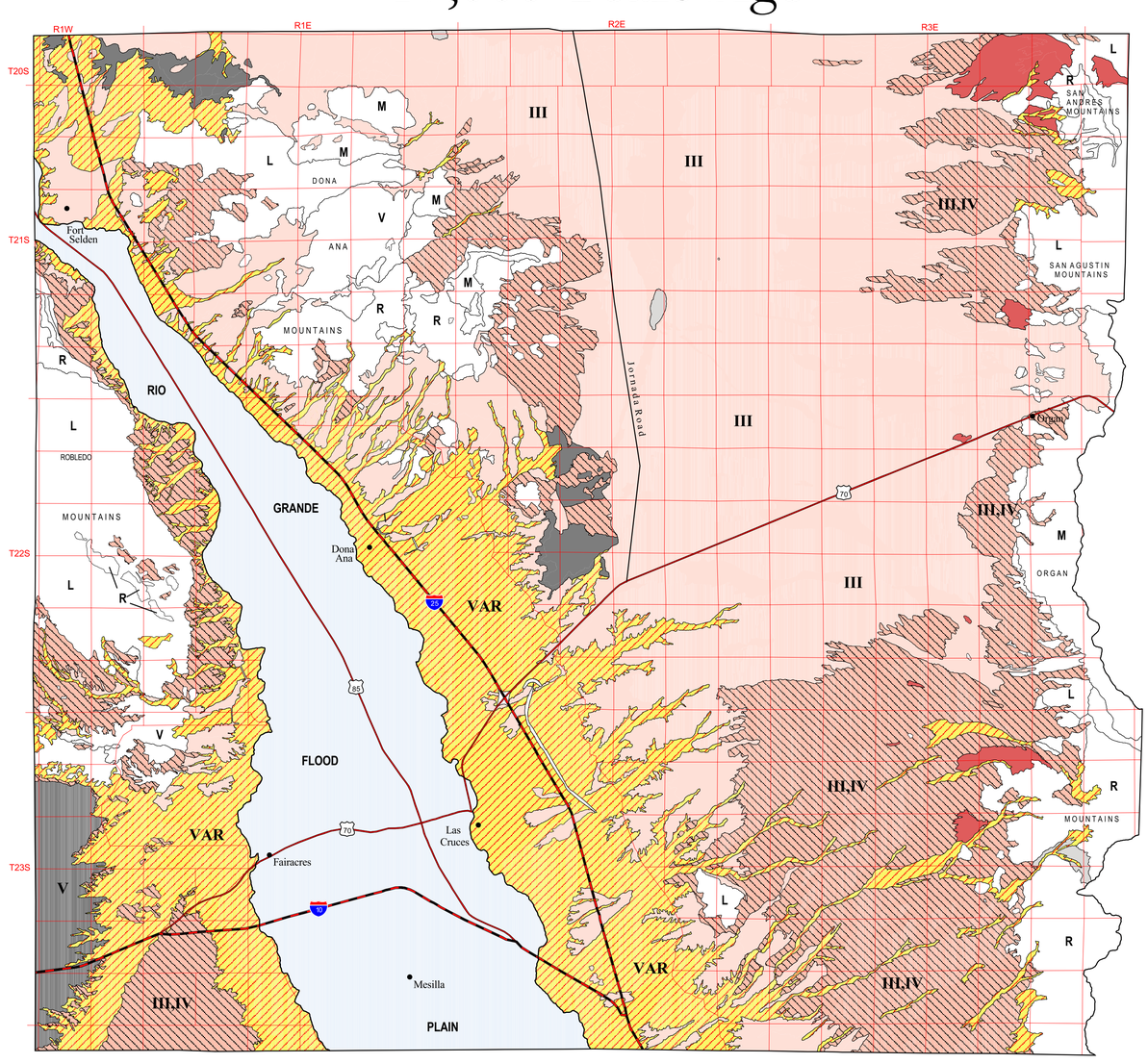
Bedrock Areas

L	Sedimentary
M	Intermediate Intrusive
R	Rhyolite
V	Volcanic (undiff.)

Includes areas of soils classified at the great group level and above. Small bedrock areas not designated (see detailed map in Volume III).

The argillic horizon was much more extensive at the end of the last Pleistocene full-glacial than now (compare with argillic horizon map). Burial of soils with argillic horizons by sediments deposited since the full-glacial and carbonate content of the parent materials are major reasons for the difference in area. Argillic horizons have not formed in post-full-glacial sediments that contain only moderate amounts of carbonate. Because more moisture was available for leaching in Pleistocene pluvials, the argillic horizon could form in sediments with higher carbonate content than is the case for sediments deposited since the full-glacial. In addition, some argillic horizons have been eroded and/or engulfed by carbonate accumulation since the end of the full-glacial.

Stages of Carbonate Accumulation 17,000 Years Ago



OCCURRENCE OF CARBONATE STAGES, 17,000 YEARS AGO

- III Carbonate nodules and/or fillings occupy at least 90% of the horizon, which is plugged in the last part of the stage (86,335 - 47)
- IV Laminae have formed atop the plugged horizon (2,190 - 1)
- V Laminae and pisoliths occur atop the plugged horizon (6,048 - 3)

Numbers in parentheses are acres and percentages respectively

MAP UNITS WITH NO OR MORE THAN ONE STAGE

- III,IV (45,370 - 25)
- None (310 - <1)
- VAR (43,787 - 24)

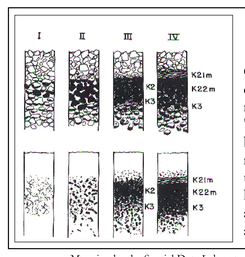
Bedrock Areas

L	Sedimentary
M	Intermediate Intrusive
R	Rhyolite
V	Volcanic (undiff.)

Includes areas of soils classified at the great group level and above. Small bedrock areas not designated (see detailed map in Volume III).

Stages indicated are dominant for the map unit. No Stage I and II horizons are shown because they have formed almost entirely in materials deposited since the last full-glacial (see soil chronology maps). Stage V includes some stages III and IV, which occur mostly along scarps. Some units designated stage IV have small areas of stage III, estimated to occupy less than 10 percent of the unit. Some delineations of units designated III and IV contain quite high percentages of stage IV, but the unit as a whole contains more than 10 percent of stage III.

VAR: materials buried by post-glacial sedimentation are highly variable in some areas, and occur as erosion surfaces and arroyos along the valley borders, where the materials consist mostly of sandy C horizon material. Along the mountain fronts, materials in and along arroyos range from C horizon materials to soils with stage III or IV carbonate.



Morphogenetic Sequences

Carbonate accumulates in two morphogenetic sequences, one in nongravelly materials and the other in gravelly materials. Morphologies are best expressed where "nongravelly" materials contain less than about 20% by volume of gravel, and "gravelly" materials contain more than about 60% by volume of gravel. Materials that have between 20% and 60% by volume of gravel have intermediate morphologies. See stages of carbonate accumulation in legend. Stage V not shown in diagram at left.

Mapping by the Spatial Data Laboratory, United States Department of Agriculture, Agricultural Research Service, Jornada Experimental Range with funding and support by the USDA and the National Science Foundation Jornada Long-Term Ecological Research (LTER) program (Grant DEB-94-11971). Map date: 23 Aug 2003.