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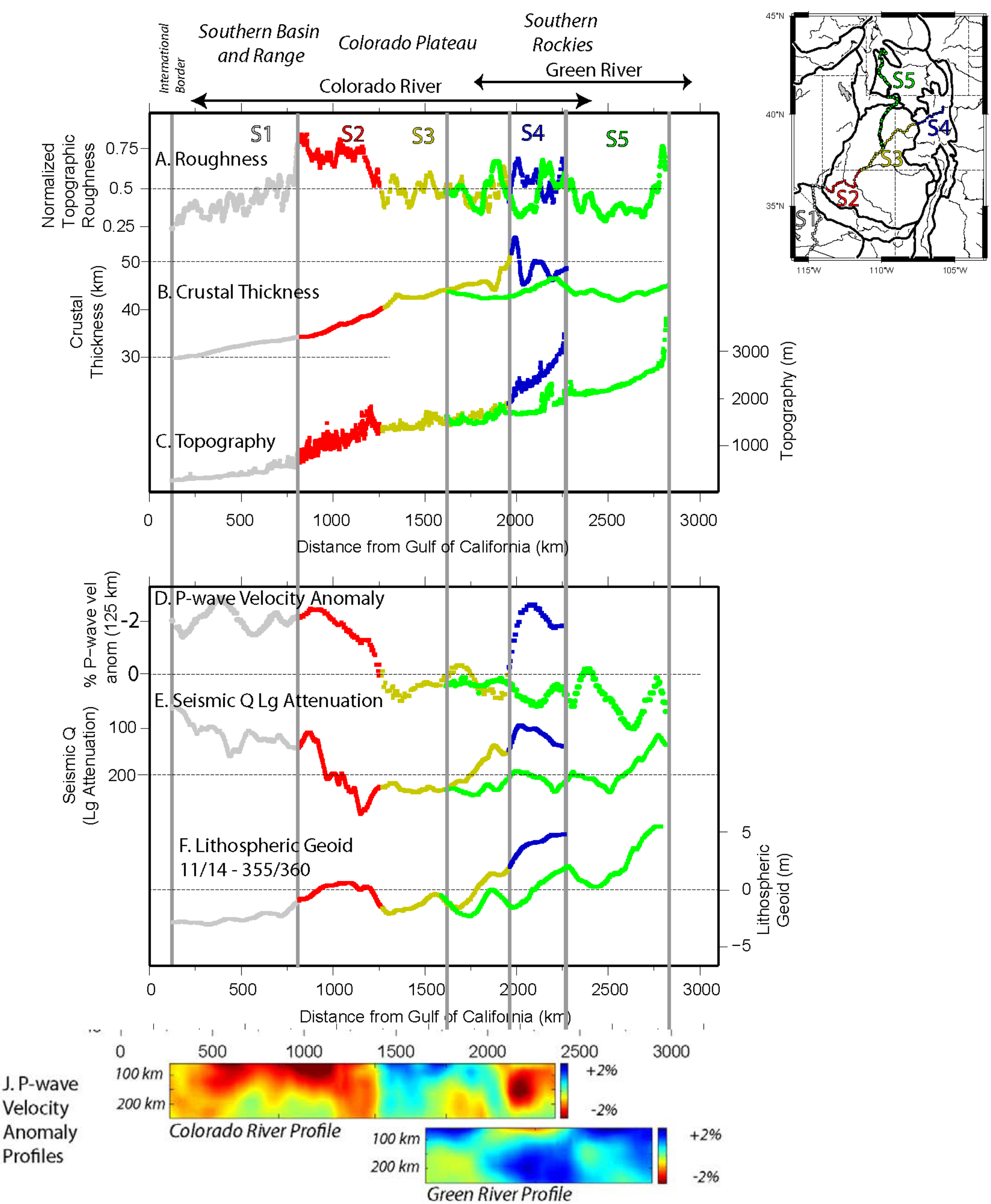

Figure DR-1. Correlations amoung various topographic and geophysical parameters along the Colorado River profile (see next page for explanation)

Figure DR-1. Graphs of geophysical and geomorphic variations from maps of Figure 1 drawn parallel to the Colorado and Green River profiles. Variations in topographic parameters correspond to changes in lithospheric substrate for the Green and Colorado River systems. Note that Segment 1 (gray) is below Grand Canyon, Segment 2 (red) is Grand Canyon, Segment 3 (Yellow) is the Colorado Plateau reach of the Colorado River, Segment 4 (blue) is the Rocky Mountain reach of the Colorado River, and Segment 5 (green) is the Green River above the confluence. This expands on the treatment in Figure 2. The river profile shown in Figure DR1 was derived from a 90 m DEM, and hence has more artifacts than the profile shown in Figure 2. The central Colorado Plateau (Segment 3) and Green River (Segment 5) have higher mantle velocities and lower river gradients than the adjacent Grand Canyon reach (Segment 2) and Colorado Rockies reach (Segment 4). These changes are mimicked by lower roughness (Fig. DR1A), crustal attenuation (Fig. DR1E), and geoid anomaly (Fig. DR1F) of the Colorado Plateau reach relative to adjacent upstream and downstream reaches. Crustal thickness beneath the river is highly variable as it crosses the White River and Breckenridge deep Moho areas in the Rockies, but the river profile does not reflect these crustal thickness variations. Overall, the information illustrated in figure DR1 is most consistent with the hypothesis that steeper river gradients and higher topographic roughness are a surface response to mantle forcing and resulting surface uplift in regions underlain by low velocity mantle.

TABLE DR 1. SUMMARY OF COLORADO PLATEAU INCISON RATES

Name	River	Strath Height (m)	Age (Ma)[§]	Dating Technique	Incision Rate (m/Ma)	Reference(s)	Latitude*	Longitude*	Notes
Pinedale, WY	Green	34	0.639 ± 0.002	Tephrachronology	**52**	Izett and Wilcox, 1982	42.8959	-110.0740	Lava Creek B ash locality
Peru Bench, WY	Green	120	1.2 ± 0.3	Cosmogenic burial isochron	**100**	Darling et al., in review	41.5867	-109.5801	
Jesse Ewing Canyon, CO	Green	49	11.8 ± 0.4	K-Ar	**4**	Damon in Winkler, 1970; Izett, 1975; Luft, 1985	40.9125	-109.1608	Volcanic ash in upper Browns Park Fm
Goodman Gulch, CO	Green	52	8.25 ± 0.7	Fission Track	**6**	Luft, 1985	40.8268	-108.9061	Volcanic ash in upper Browns Park Fm
Vermillion Creek, CO	Green	140	9.1 ± 1	Fission Track	**15**	Izett, 1975	40.7271	-108.7609	Volcanic ash in upper Browns Park Fm
Tabyago Canyon, UT	Green	60	1.48 ± 0.02	Cosmogenic burial isochron	**41**	Darling et al., in review	39.7676	-109.9050	Near Desolation Canyon kickpoint
McCoy, CO	Colorado	79	0.639 ± 0.002	Tephrachronology	**124**	Larson, et al., 1975; Aslan et al., 2007	39.9280	-106.7146	Lava Creek B ash locality
Dotsero, CO	Colorado	85	0.639 ± 0.002	Tephrachronology	**133**	Brown et al., 2007	39.6460	-107.0584	Lava Creek B ash locality
Grand Mesa, CO	Colorado	1503	10.76 ± 0.24	Ar/Ar	**140**	Kunk et al. 2002; Czapla & Aslan, 2009	39.0464	-108.2514	Basal basalt flow north of Lands End underlain by Colorado R gravels; age is from oldest (basal) flow dated by Kunk et al., 2002 at Lands End
Praire Canyon / McDonald Creek, CO	Colorado	105	0.639 ± 0.002	Tephrachronology	**164**	Aslan et al., 2010	39.1373	-109.0274	Ash occurs beneath local river gravels that project down McDonald Ck to Colorado R over a distance of ~15 miles
Bull Frog Marine, UT	Colorado	189	1.5 ± 0.13	Cosmogenic burial isochron	**126**	Darling et al., in review	37.5189	-110.6995	
Eastern Grand Canyon, AZ	Colorado	0-920	0.153 to 3.72	Ar/Ar, U-series, and U/Pb	**233**	Karlstrom et al., 2008	36.2000	-112.4000	Prefered average rate based on multiple dated straths including speleothem constrained ages of Polyak et al., 20008, location approximate based on multiple samples
Western Grand Canyon, AZ	Colorado	0-290	0.298 to 3.87	Ar/Ar and U/Pb	**78**	Karlstrom et al., 2008	35.8000	-113.4000	Prefered average rate based on multiple dated straths including speleothem constrained ages of Polyak et al., 20008, location approximate based on multiple samples
Panda Gravels near Davis Dam, NV	Colorado	43	5.5	Tephrachronology	**8**	House et al., 2005; Karlstrom et al.,	35.1397	-114.5784	Actual Panda Gravel strath may be lower
Florida Mesa, CO	Animas	123.5	0.639 ± 0.002	Tephrachronology	**193**	Gilliam, personal communication	37.2732	-107.8029	Lava Creek B ash, average of 190-195 m/Ma
Flora Vista, NM	Animas	83	0.639 ± 0.002	Tephrachronology	**130**	Gilliam, personal communication	36.7709	-108.1213	Lava Creek B ash
Bluff Quarry, UT	San Juan	140	1.36 +0.15 / -0.2	Cosmogenic burial	**102**	Wolkowinsky and Granger, 2004	37.2926	-109.5454	Strath covered by <10m of gravel. Rate of 110 m/Ma is from the terrace tread.
Sawmill Mesa, CO	Gunnison	96	0.639 ± 0.002	Tephrachronology	**150**	Darling et al., 2009	38.7239	-108.1783	Lava Creek B ash locality near Kelso Gulch

§ Error reported as in original publication (may be a mix of 1 and 2 sigma errors)

* Estimated from description if exact location was not given, using NAD83 datum

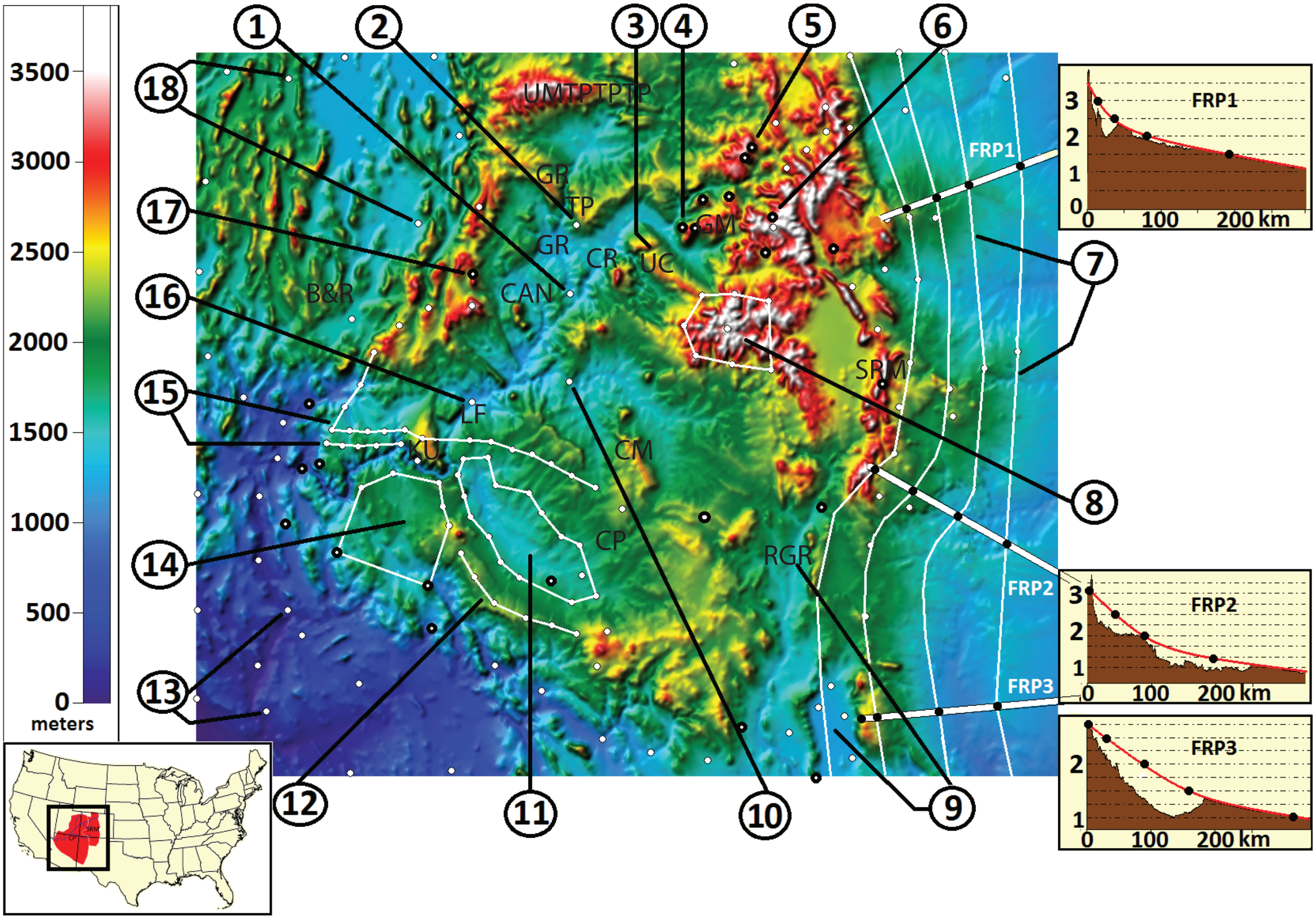

Figure DR-2. Topographic image of the Colorado Plateau (CP), Southern Rocky Mountains (SRM), and Basin and Range (B&R) showing control points used to define the 10 Ma paleo-surface (see Table DR1). Black dots are 8-12 Ma basalt flows, white dots are thermochronometry data points and other elevation constraints for the inferred paleo-surface. These additional control points aid in reducing artifacts in the triangular interpolation algorithm. Other points of interest are CAN = Canyonlands region, CM = Chuska Mountains, CR = Colorado River, KU= Kaibab Uplift and eastern Grand Canyon regionTP, GM = Grand Mesa, GR = Green River, LF = Lees Ferry, TP = Tavaputs Plateau, UM = Uinta Mountains, UC = Unaweep Canyon of Uncompahgre Uplift.

TABLE DR 2 - EXPLANATION OF CONTROL POINTS FOR 10 MA PALEO-SURFACE

Location*	Description
1	2-3 km of section eroded from Canyonlands near confluence of Green and Colorado rivers since 4-6 Ma (Hoffman et al., 2010)
2	~2 km of section removed from Book Cliffs region since 4-6 Ma (Hoffman et al., 2010)
3	Colorado River gravels are preserved under 10 Ma basalt flows on Grand Mesa (Aslan et al.,2010)
4	The Colorado River flowed over the Uncompahgre Uplift prior to carving Unaweep Canyon (Aslan et al.,2010)
5 and 6	10 Ma basalts constrain elevations in the southern Rocky Mountains, and Colorado River gravels document the course of the river 10 Ma
7	Profiles through the eroded piedmont east of the Rockies were used to define the present elevation of erosional remnants of the Miocene-Pliocene Ogallala Group with post-depositional tilt (McMillan et al., 2002; Leonard, 2002)
8	~2 km of volcanic edifice eroded from the Needle Mts. and Mt. Sneffels since 10 Ma (Kelley et al.,2010)
9	Basins along the Rio Grande rift formed prior to 10 Ma
10	1-2 km of section eroded from the Monument Uplift since 6 Ma (Hoffman et al., 2010)
11	Basin of present Little Colorado River was occupied by Hopi Lake from 16-6 Ma and formed by 1230 m of incision into the Chuska Erg between 28-16 Ma (Cather et al., 2009)
12	Southern rim of the Colorado Plateau has been armored by volcanic fields since Oligocene.
13	Control points define elevations in the Basin and Range taht developed prior to 10 Ma.
14	Between 20-10 Ma most Mesozoic section was removed and a paleo-canyon incised through the Kaibab Ls. coincident with the present eastern Grand Canyon (Lee et al., 2010)
15	Control points define the position of a 2 km escarpment of the Mesozoic section just north of present Grand Canyon 10 Ma (Lee et al., 2010)
16	Mesozoic section was 2 km thick over Lees Ferry 10 Ma (Lee et al., 2010)
17	Elevation of the western rim of the Colorado Plateau is preserved under 10 Ma basalt flows. Some down faulting has occurred along the margin of the Basin and Range making these minimum elevation estimates for the 10 Ma surface.
18	Elevations of the basins in the Northern Basin and Range formed prior to 10 Ma.

* Locations are keyed to figure DR 1