GSA Data Repository Item 2020194

Suoya Fan and Michael A. Murphy, 2020, Three-dimensional strain accumulation and partitioning in an arcuate orogenic wedge: An example from the Himalaya: GSA Bulletin, https://doi.org/10.1130/B35528.1.

Data Repository

APPENDIX 1. Data sources of the 3D database for geometric modeling

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Appendix 1 Data sources of the 3D database for geometric modeling

(a) Geologic maps, cross-sections, and their references of the integrated database for the 3D geometric modeling

The modeled 3D surfaces of the STD and MCT are constrained by the maps and cross-sections from Amatya and Jnawal (1994); Ambrose et al. (2015); Baltz (2012); Cannon and Murphy (2014); Carosi et al. (2010, 2013, 2016, 2018); Célérier et al. (2009a, b); Das et al. (2016); DeCelles et al. (2001); Godin (2003); Godin et al. (2006); He et al. (2014); Hubbard et al. (2016); Iaccarino et al. (2017a, b); Kumar et al. (2017); Larson et al. (2010, 2017); Montomoli et al. (2013); Murphy and Yin (2003); Murphy et al. (2002, 2005); Nadin and Martin (2012); Pan et al. (2004); Parsons et al. (2016); Pearson and DeCelles (2005); Robinson et al. (2006); Schelling (1992); Searle and Godin (2003); Searle et al. (2003, 2017); Shrestha et al. (2017); Silver et al. (2015); Wang et al. (2015); Webb (2013); Webb et al. (2011a, b, 2013); Yakymchuk and Godin (2012); Yu et al. (2015); Zhang et al. (2011). We adopted the original interpretation as much as possible and only made necessary minor modification when interpretations from different studies conflict with each other over a short distance or overlapped study area. The minor modification would not affect the first order observations made in this study.

The blue lines in the figure below (Fig. DR1) show the traces of the published cross-sections used in this study (Ambrose et al., 2015; Baltz, 2012; Caldwell et al., 2013; Célérier et al., 2009b; Das et al., 2016; DeCelles et al., 2001; Godin, 2003; He et al., 2014; Hubbard et al., 2016; Iaccarino et al., 2017a; Murphy and Copeland, 2005; Murphy and Yin, 2003; Murphy et al., 2002; Parsons et al., 2016; Robinson et al., 2006; Searle et al., 2017; Searle and Godin, 2003; Webb et al., 2011b; Yu et al., 2015; Zhang et al., 2011). The red lines show the traces of our cross-sections in this study. They are modified from the adjacent published cross-sections based on the geologic maps.

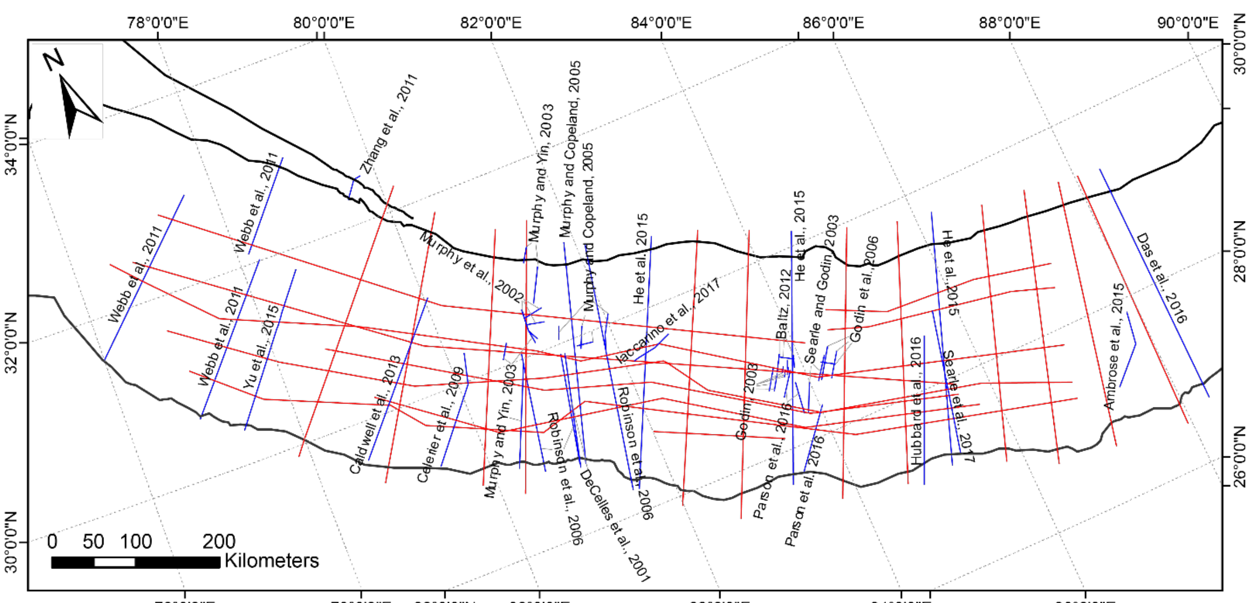


Figure DR1. A map of the traces of the cross-sections used for the geometric modeling of the STD, MCT, and MHT. The blue traces labeled with references are published cross-sections. The red traces are newly constructed cross-sections based on the geologic maps and published adjacent cross-sections in this study.

(b) Data for the MHT in the integrated database for the 3D geometric modeling.

For the Nepal area, we adopted the 3D model of the MHT published by Hubbard et al. (2016). Their model assumed a flat of constant slope in the hinterland. We extended the model northward to the location below the trace of the GCT assuming the slope is constant.

For the area to the west of the Nepal, we reinterpreted the seismic profile published by Caldwell et al. (2013) (Fig. DR2) and used it by extending the reinterpreted MHT along the strike of Himalaya assuming identical geometry. The location of the profile is shown in the map above (a). In their interpretation, the MHT goes through low (negative) Ps/P value at the upper flat and high (positive) Ps/P value at the lower flat, and the ramp is to the south of a ramp-shaped area of low (negative) Ps/P. The MHT is the largest structural discontinuity in the Himalaya. It is unreasonable to interpret the MHT using inconsistent criteria along the dip direction without any other information that can explain it. The green line is our new interpretation, which approximately follows the low Ps/P value. It is also more consistent with the model proposed by Hubbard et al. (2016) in Nepal area: Although we artificially made the two models connect smoothly, there is no significant abrupt lateral change, especially for the hinterland part where the paper is focused on (Fig. 2 in the manuscript). Moreover, our first-order observation in this study is that the thickness of the orogenic core, bounded by the MHT at the bottom, in the western Himalaya is significantly thinner than the central Himalaya, whereas the original interpretation of the MHT in Caldwell et al. (2013) favors a shallower lower flat, which, if adopted, will relatively underestimate the thickness by about 6.7 km and only make the trend we observed more outstanding.

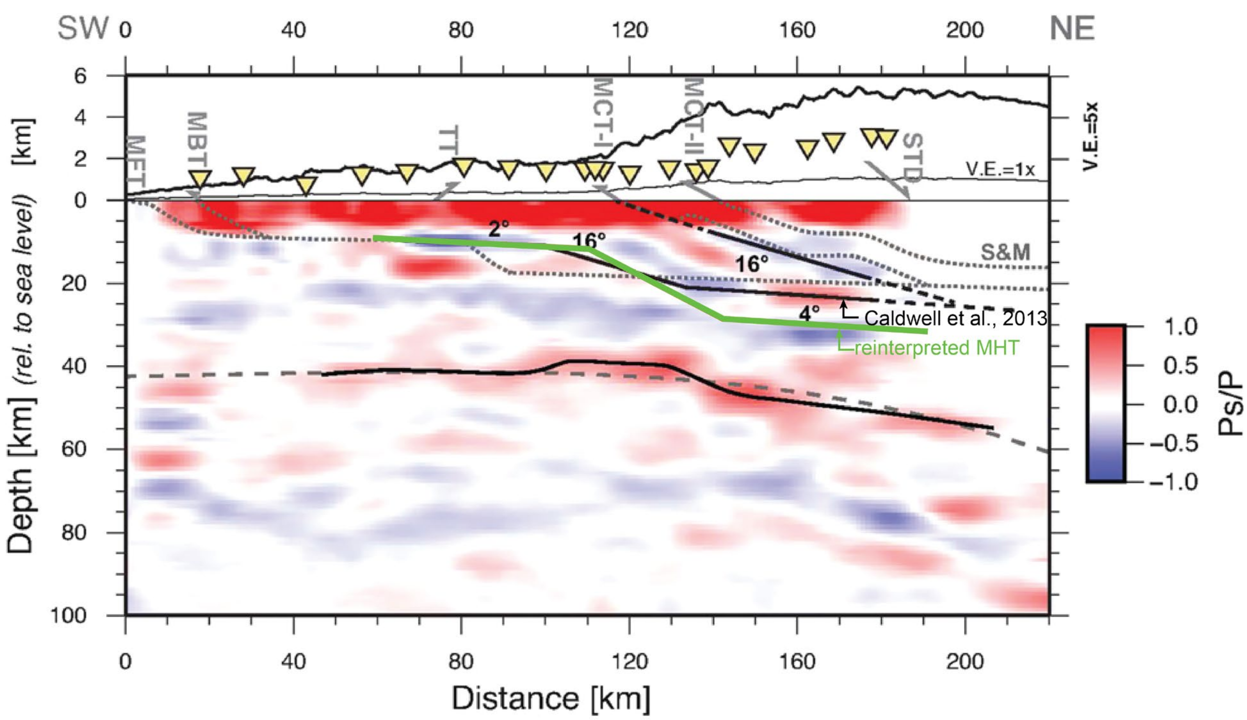


Figure DR2. The seismic profile from Caldwell et al. (2013) and the reinterpreted model (green line) of the MHT.

Appendix 2 3D-view models

The figure DR3(a) shows the color-coded 3D model of the STD, MCT, and the MHT. Warm color (red) represents high elevation and cold color (blue) represents low elevation of each modeled surface.

The figure DR3(b) shows the 3D model of the high-grade metamorphic core of the western-central Himalaya.

3D model of the MHT, MCT, and STD

Fig. DR3 (a)

Created using

High Grade Metamorphic Core of the Western and Central Himalaya

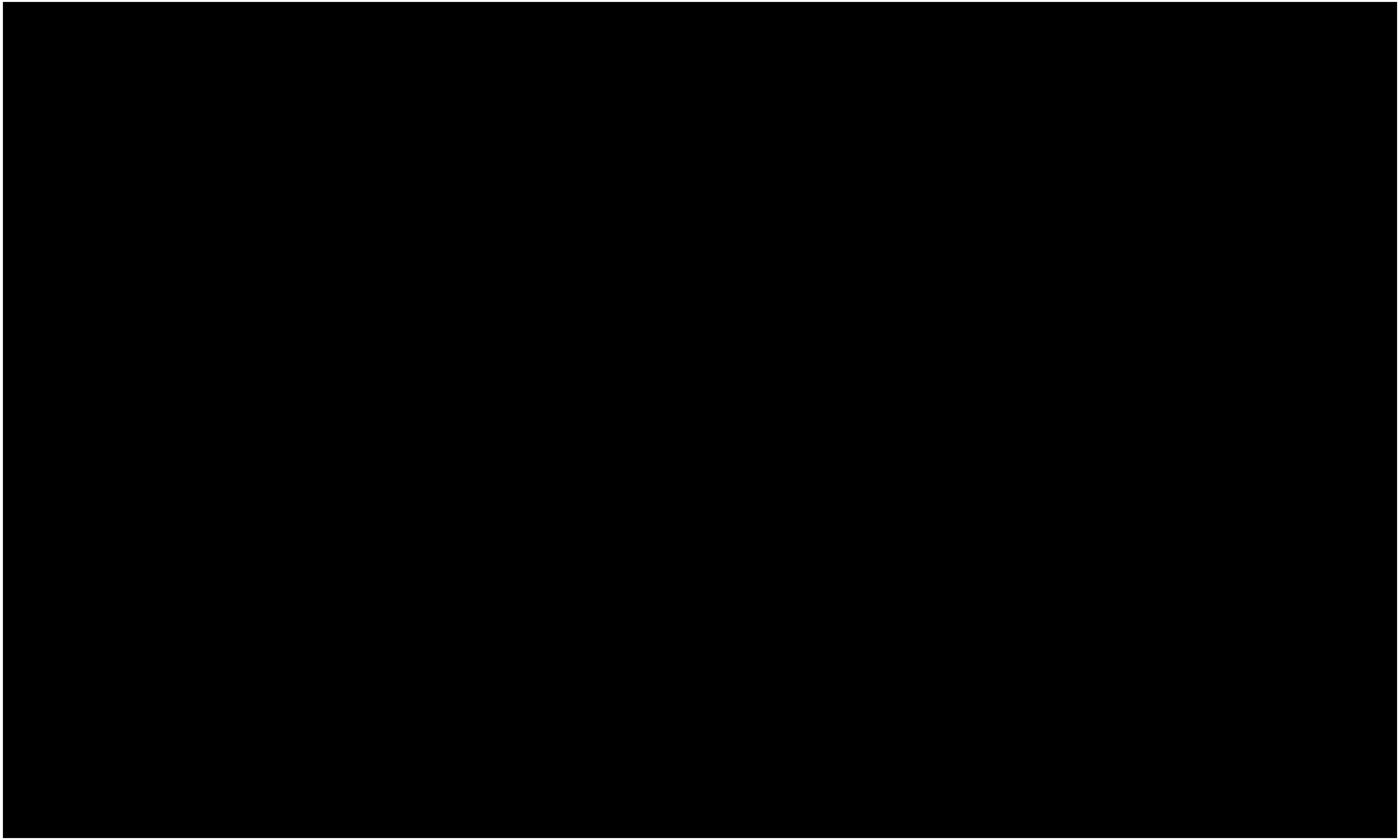


Fig. DR3 (b)

Appendix 3 Supplementary table

Table DR1. A summary of the P-T-t data of the "Eohimalayan" metamorphism

Area	Sample	Pressure (Mpa)	Temperature (℃)	Ages (Ma)	References
Marsyandi Valley	hanging wall of the STD	-	-	~30, Biotite and Phlogopite $^{40}Ar/^{39}Ar$	Coleman and Hodges (1998)
Annapurna Range	AS31, leucogranitic orthogneiss (GHS)	-	-	36.3±0.4, monazite U-Pb	Hodges et al. (1996)
Dinggye	GHS	-	-	~25 Ma, $^{40}Ar/^{39}Ar$ hornblende	Hodges et al. (1994)
Kali Gandaki valley	GHS	940	610	37.2±2.8, $^{40}Ar/^{39}Ar$ hornblende	Vannay and Hodges (1996)
Marsyandi	GHS (MA45)	~1000	~735	37.5±0.3, monazite U-Pb	Catlos et al. (2001)
Eastern Nepal	GHS, Namche Migmatite Orthogneiss (ET19)	930	778	33.1±0.5, monazite U-Pb	Catlos et al. (2002)
		1110	882		
Western syntaxis	GHS	800-1300	650-700		Pognante et al. (1993)
	kl-21	-	-	39-32, monazite U-Pb	
Northwestern Nepal	GHS (highest P in transect)	~1060	~728	Eohimalaya	Yakymchuk and Godin (2012)
Kali Gandaki valley	GHS	-	-	41-36, monazite U-Pb (nanogranites in garnet)	Carosi et al. (2015)
Kalopani shear zone	kl-19 (PT represent shear zone conditions)	600-850	600-660	48-41, monazite U-Pb (prograde stage)	Carosi et al. (2016)
Lower Dolpo	GHS (footwall of Toijem shear zone)	745-896	643-665	43-39, monazite U-Pb	Carosi et al. (2010)
Central Nepal	GHS (kyanite-garnet gneiss)	1000-1100	710-720	36-28, monazite U-Pb	Iaccarino et al. (2015)
Central Nepal	GHS (kyanite-grade metamorphic rocks)	-	-	35-32, monazite U-Pb	Godin et al. (2001)

Appendix 4 Supplementary maps and their data source

Figure DR4. (a-d) are maps showing the published apatite fission track (AFT) ages (a), zircon fission track (ZFT) ages (b), zircon (U-Th)/He ages (ZHe) and apatite (U-Th)/He ages (AHe) (c), and muscovite $^{40}Ar/^{39}Ar$ ages (d). (e) and (f) show the distribution of river Ksn value (Cannon et al., 2018) and seismicity (03/06/1996-12/01/2018) Seismicity data is from the U.S. Geological Survey National Earthquake Information Center (https://earthquake.usgs.gov/earthquakes/search).

The data sources of our age database are listed below.

AFT ages (a): Blythe et al. (2007); Burbank et al. (2003); Deeken et al. (2011); Herman et al. (2010); Huntington et al. (2006); Nadin and Martin (2012); Patel and Carter (2009); Patel et al. (2015); Robert et al. (2009); Robert et al. (2011); Schlup et al. (2011); Singh et al. (2012); Streule et al. (2012); Thiede et al. (2005); Thiede et al. (2004); Thiede et al. (2009); van der Beek et al. (2016)

ZFT ages (b): Blythe et al. (2007); Crouzet et al. (2007); Patel and Carter (2009); Schlup et al. (2011); Singh and Patel (2016); Streule et al. (2012)

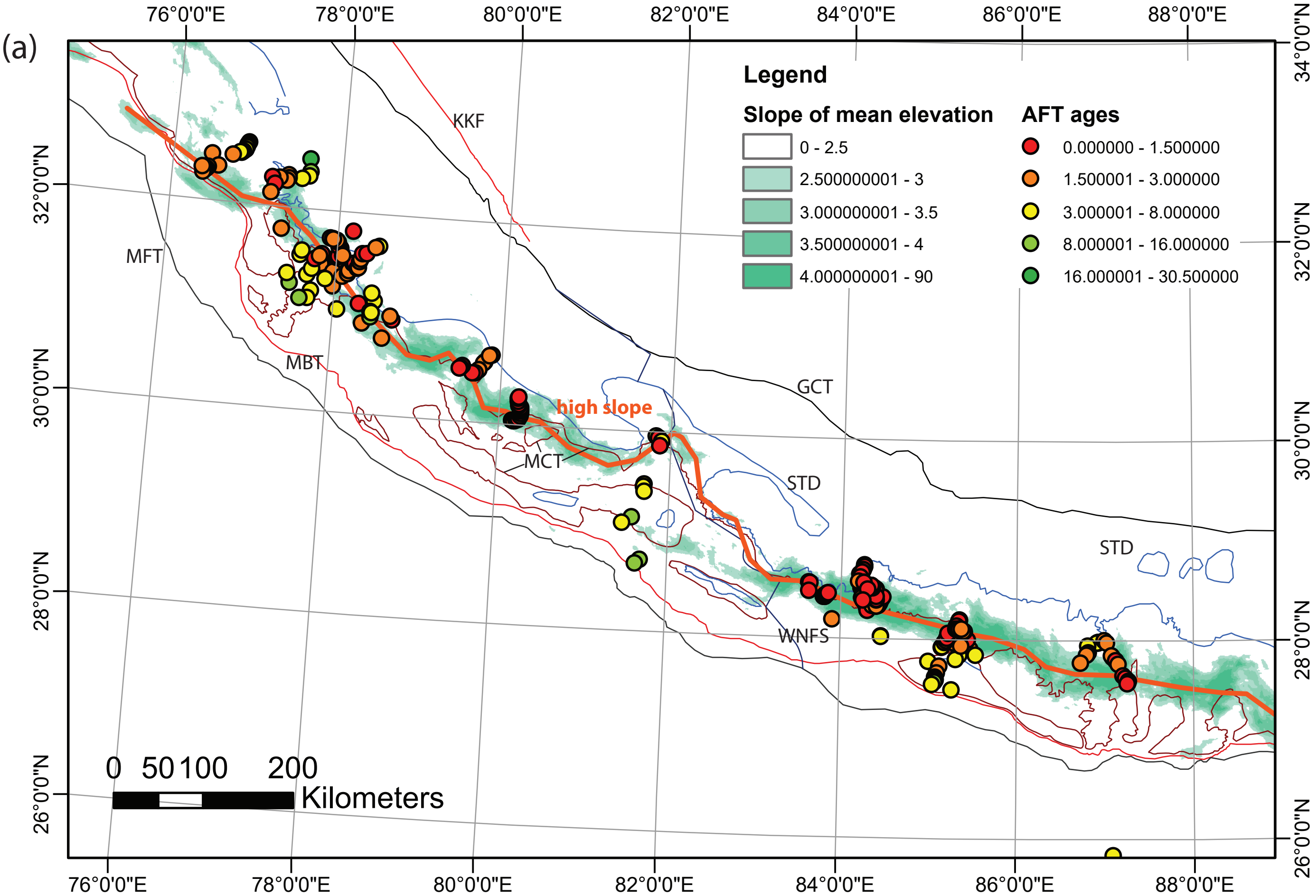
ZHe ages (c): Colleps et al. (2018); Deeken et al. (2011); Herman et al. (2010); McCallister et al. (2014); Morell et al. (2017); Stübner et al. (2018); Thiede et al. (2017)

AHe ages (c): Blythe et al. (2007); Nadin and Martin (2012)

Muscovite $^{40}Ar/^{39}Ar$ ages (d): Bollinger et al. (2004); Catlos et al. (2001); Célérier et al. (2009a); Coleman and Hodges (1995); Copeland and Harrison (1990); Edwards et al. (1995); Gibson et al. (2016); Godin et al. (2001); Herman et al. (2010); Huntington et al. (2006); Martin et al. (2015); Schlup et al. (2011); Stübner et al. (2014); Stübner et al. (2017); Vannay and Hodges (1996)

Fig. DR4 continued

(a)



(b)

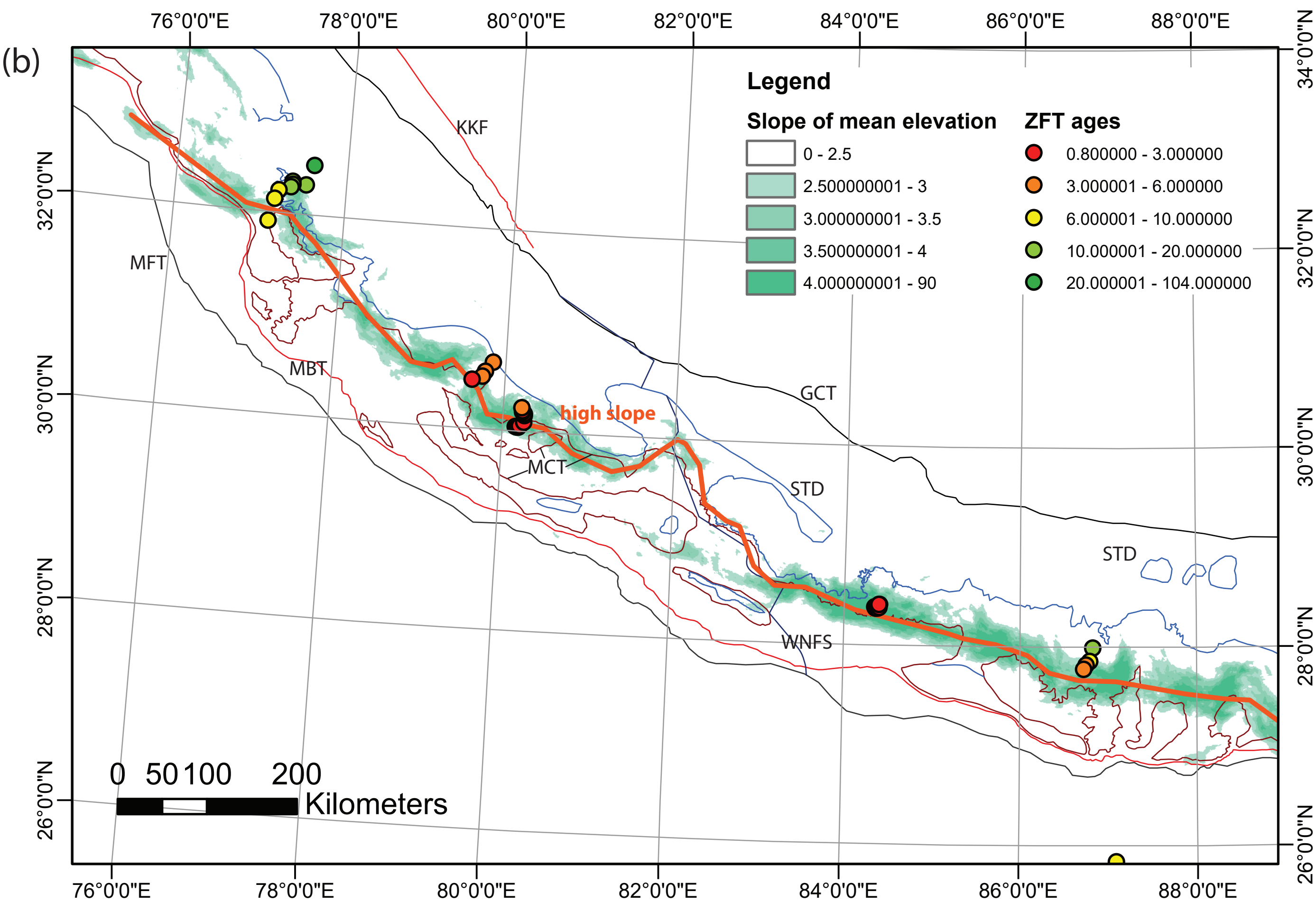
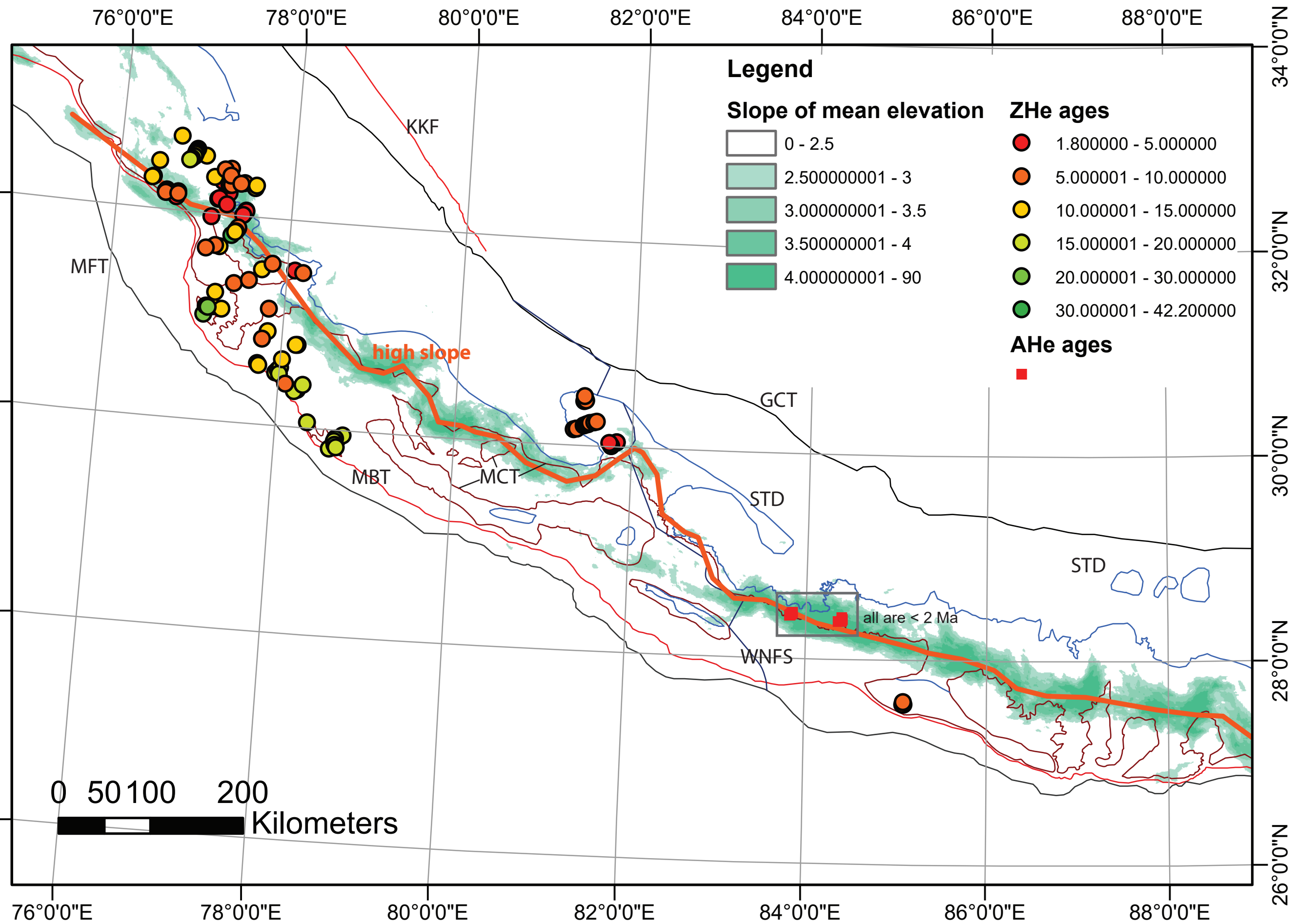


Fig. DR4 continued

(c)



(d)

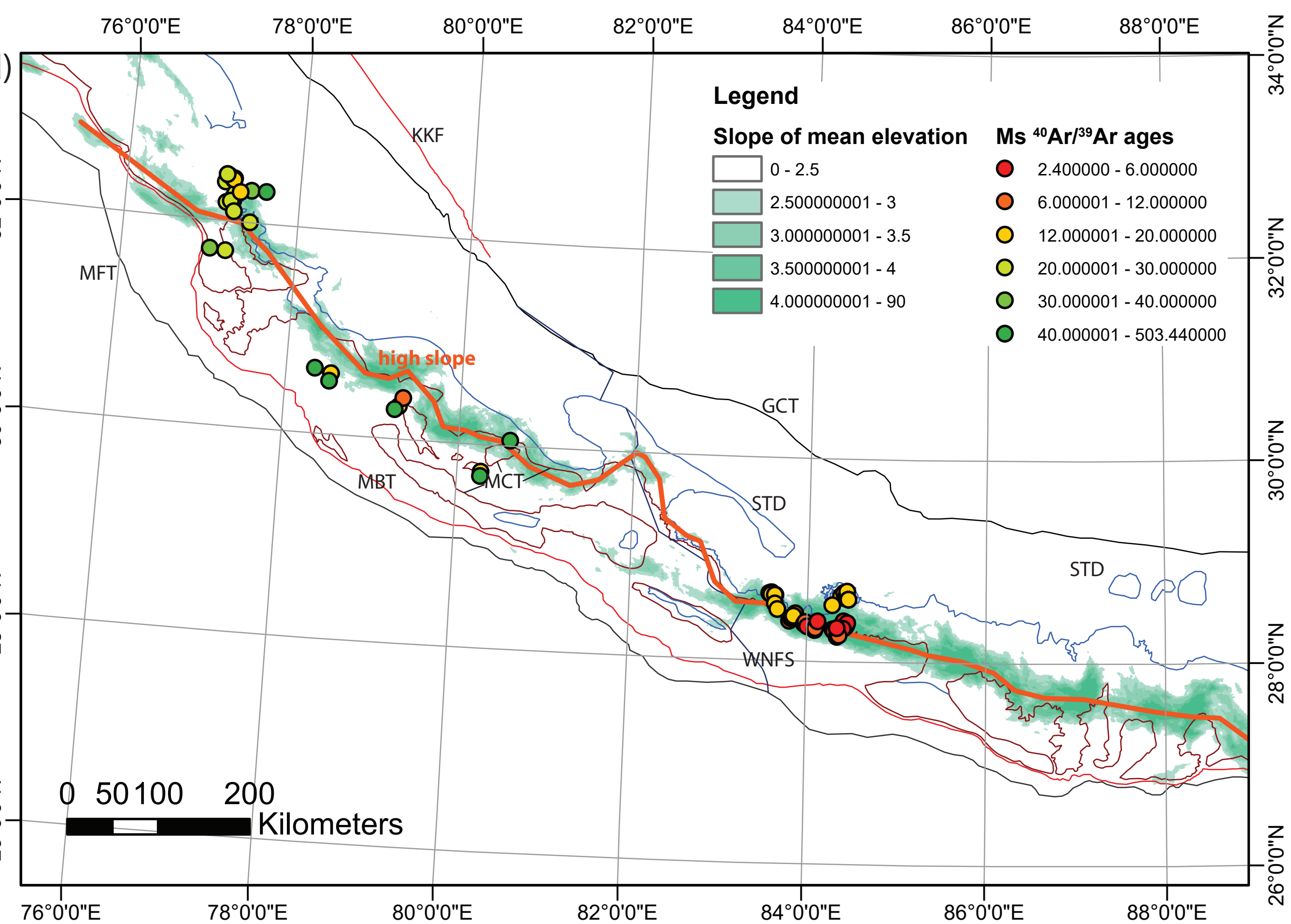
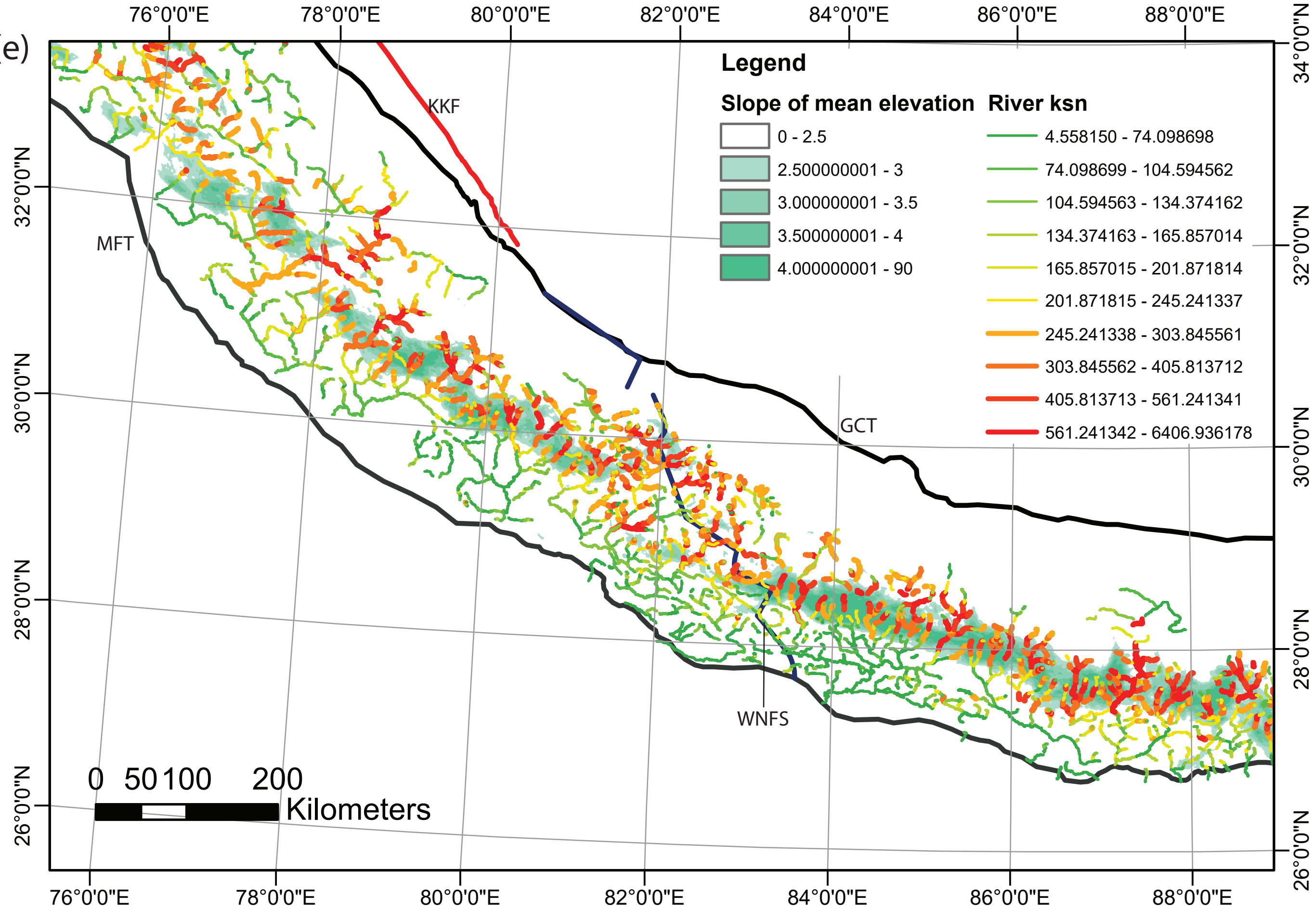
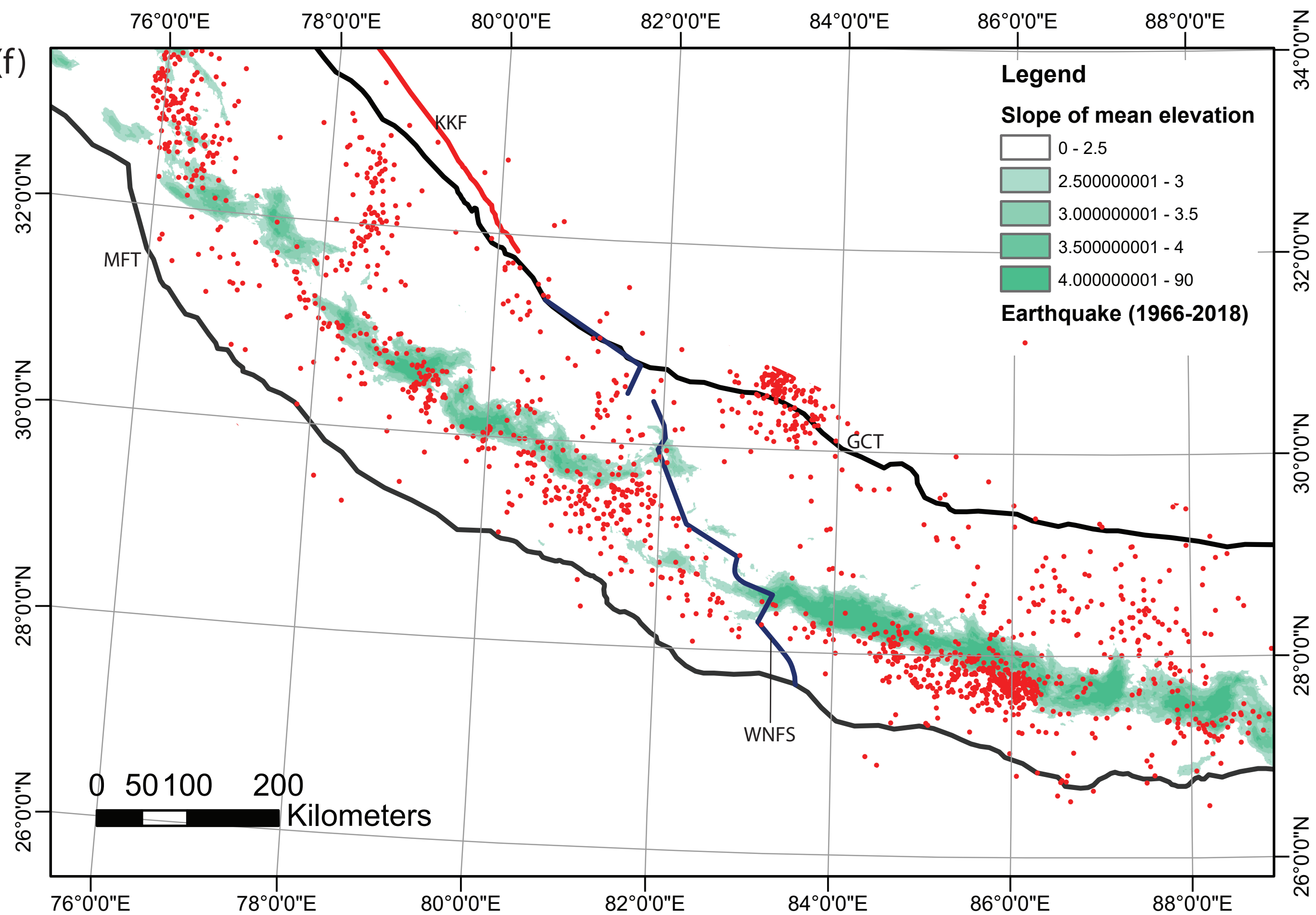


Fig. DR4 continued

(e)



(f)



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