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Probable and possible Quaternary faults in Afghanistan

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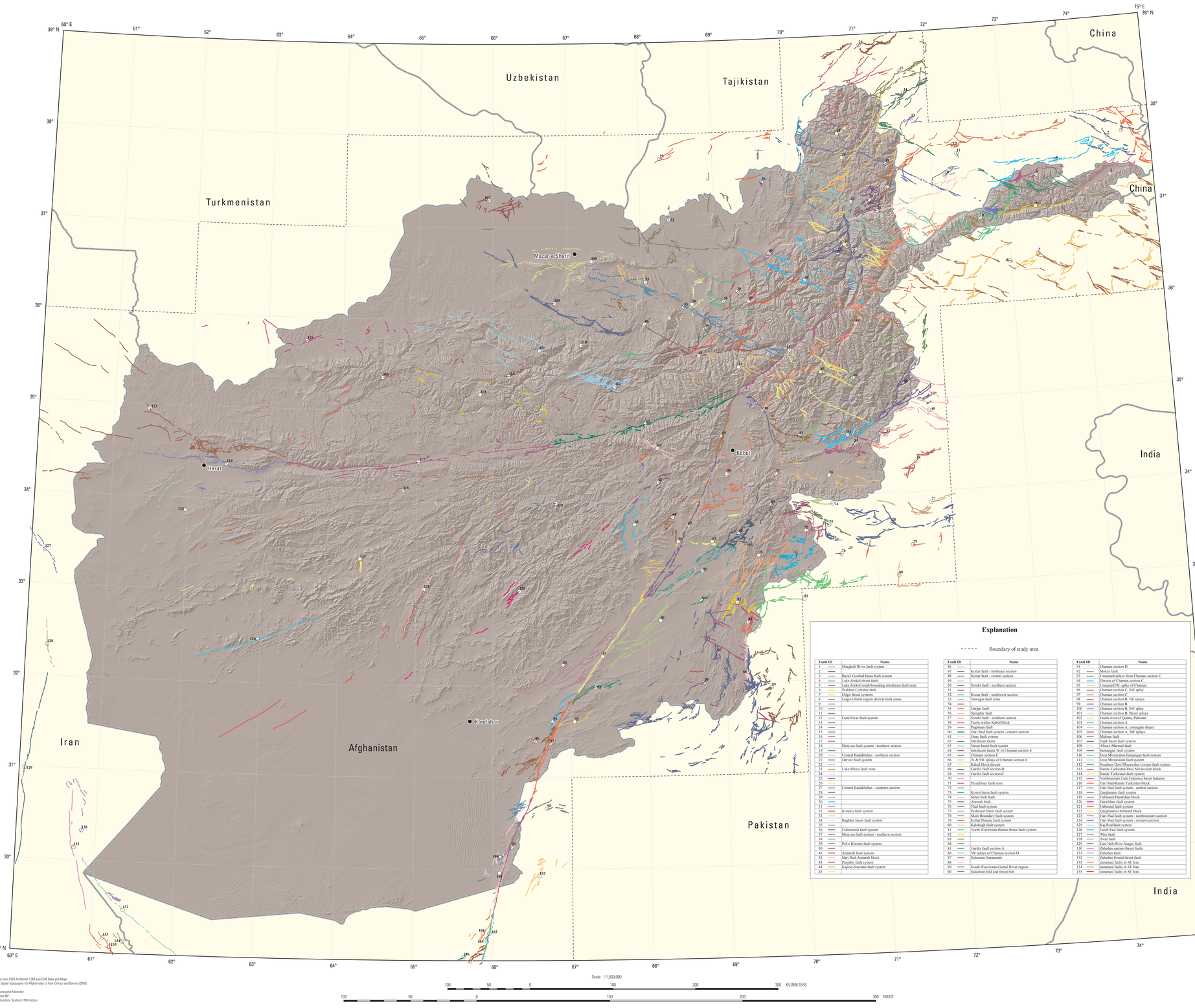
2007



Fault ID	Name
1	Murghob River fault system
2	
3	Bazgi Goobad basin fault system
4	Lake Zorkol thrust fault
5	Lake Zorkol south-bounding intrabasin fault zone
6	Wakhan Corridor fault
7	Gilgit thrust systems
8	Gilgit-Chitral region dextral fault zones
9	
10	
11	
12	Guzi River fault system
13	
14	
15	
16	
17	
18	Henjvan fault system - northern section
19	
20	Central Badakhshan - northern section
21	Darvaz fault system
22	
23	Lake Shiwa fault zone
24	
25	
26	
27	Central Badakhshan - southern section
28	
29	
30	
31	
32	Kondoz fault system
33	
34	Baghlan basin fault system
35	
36	Eshkamesh fault system
37	Henjvan fault system - southern section
38	
39	Pol-e Khomri fault system
40	
41	Andarab fault system
42	Hari Rud-Andarab block
43	Panjshir fault system
44	Kapisa-Nuristan fault system
45	

Fault ID	Name
46	
47	Konar fault - northeast section
48	Konar fault - central section
49	
50	Sorubi fault - northern section
51	
52	Konar fault - southwest section
53	Nawagai fault zone
54	
55	Dargai fault
56	Spoghar fault
57	Sorubi fault - southern section
58	Faults within Kabul block
59	Paghman fault
60	Hari Rud fault system - eastern section
61	Otuay fault system
62	Intrabasin faults
63	Navar basin fault system
64	Intrabasin faults W of Chaman section E
65	Chaman section E
66	W & SW splays of Chaman section E
67	Kabul block thrusts
68	Gardiz fault section B
69	Gardiz fault section C
70	
71	Parachinar fault zone
72	
73	Kuwei basin fault system
74	Safed Koh fault
75	Arawali fault
76	Thal fault system
77	Peshawar basin fault system
78	Main Boundary fault system
79	Kohat Plateau fault system
80	Kalabagh fault system
81	North Waziristan-Bannu thrust fault system
82	
83	
84	
85	Gardiz fault section A
86	NE splays of Chaman section D
87	Sulaiman lineaments
88	
89	South Waziristan-Gumal River region
90	Sulaiman fold and thrust belt

Fault ID	Name
91	Chaman section D
92	Mokur fault
93	Unnamed splays from Chaman section C
94	Thrusts of Chaman section C
95	Unnamed NE splay of Chaman
96	Chaman section C SW splay
97	Chaman section C
98	Chaman section B, NE splays
99	Chaman section B
100	Chaman section B, SW splay
101	Chaman section B, thrust splays
102	Faults west of Quetta, Pakistan
103	Chaman section A
104	Chaman section A, overnight shears
105	Chaman section A, SW splays
106	Makran fault
107	Tejik basin fault system
108	Alburz-Marmul fault
109	Sarmargan fault system
110	Dosi Mirzavalen-Samangan fault system
111	Dosi Mirzavalen fault system
112	Southern Dosi Mirzavalen reverse fault system
113	Bande Turkestan-Dosi Mirzavalen block
114	Bande Turkestan fault system
115	Northwestern Late Cenozoic basin features
116	Hari Rud-Bande Turkestan block
117	Hari Rud fault system - central section
118	Qurghanaw fault system
119	Helmand-Darahban block
120	Darafshan fault system
121	Helmand fault system
122	Qurghanaw-Helmand block
123	Hari Rud fault system - northwestern section
124	Hari Rud fault system - western section
125	Kaj-Rud fault system
126	Farah Rud fault system
127	Abe fault
128	Avaz fault
129	Kan Nah-West Asagie fault
130	Zabodan eastern thrust faults
131	Zabodan fault
132	Zabodan frontal thrust fault
133	unnamed faults in SE Iran
134	unnamed faults in SE Iran
135	unnamed faults in SE Iran

Base map data from ESRI ArcWorld 1:3M and ESRI Data and Maps
Shaded-relief digital topography for Afghanistan is from Divico and Barrios (2005)

Projection: Transverse Mercator
Central Meridian 66°
WGS (World Geodetic System) 1984 datum

Scale 1:1,500,000
100 50 0 100 200 300 KILOMETERS
100 50 0 100 200 300 MILES

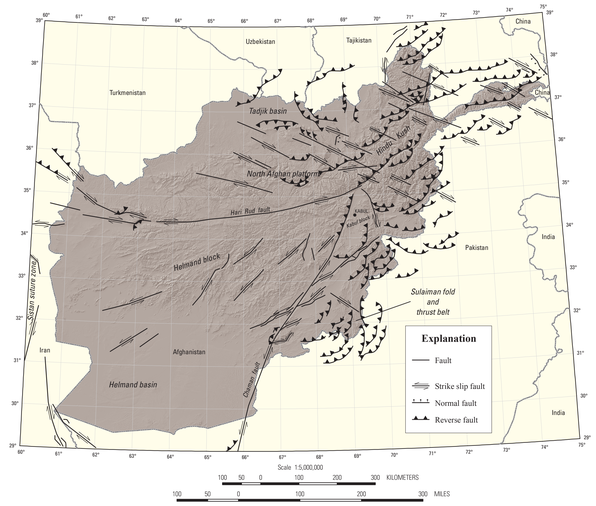


Figure 1. Kinematic model for probable and possible Quaternary faults in Afghanistan. Based on our remote-sensing analyses, we have identified kinematic indicators for fault displacement (for example, shutter ridges and displaced geologic units and landforms) in order to construct a preliminary model for the kinematic mechanics of crustal deformation in Afghanistan. Field-based studies have not been performed to confirm our observations. However, initial interpretations provide a basic model to enhance as more investigations occur.

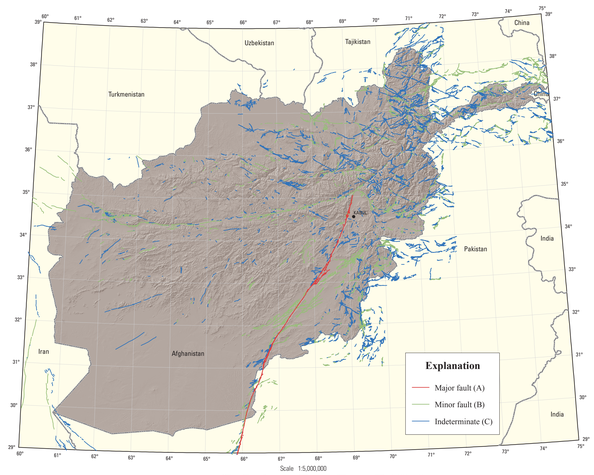


Figure 2. Based on characteristics of the surficial expression of faulting, we have subdivided mapped probable and possible Quaternary faults into three categories: A, B, and C. Category A faults are considered to be major structures with a prominent expression in the landscape and are likely to play an important role in seismic hazards. Based on the similarity in surficial expression to other faults of known slip rate within the region, we assign a slip rate of >10 mm/yr to these faults. Category B faults are minor structures that have a distinct expression in the landscape and could be significant contributors to Afghanistan's seismic hazard. The surficial expression of faulting is easily traceable, but more discontinuous than category A faults, indicating possible longer recurrence times and slower slip rates. We assign category B faults a slip rate of 1–10 mm/yr. Category C faults are structures that have a subtle expression in the landscape or that have limited or poor expression in Quaternary deposits, but could possibly contribute to the seismic hazard. Category C faults have an indeterminate slip rate.

ABSTRACT

The U.S. Geological Survey (USGS), with support from the U.S. Agency for International Development (USAID) mission in Afghanistan, has prepared a digital map showing the distribution of probable and suspected Quaternary faults in Afghanistan. This map is a key component of a broader effort to assess and map the country's seismic hazards. Our analyses of remote-sensing imagery reveal a complex array of tectonic features that we interpret to be probable and possible active faults within the country and in the surrounding border regions. In our compilation, we have mapped previously recognized active faults in greater detail, and have categorized individual features based on their geomorphic expression. We assigned mapped features to eight newly defined domains, each of which contains features that appear to have similar styles of deformation. The styles of deformation associated with each domain provide insight into the kinematics of the modern tectonism, and define a tectonic framework that helps constrain deformational models of the Alpine-Himalayan orogenic belt.

The modern fault movements, deformation, and earthquakes in Afghanistan are driven by the collision between the northward-moving Indian subcontinent and Eurasia. The patterns of probable and possible Quaternary faults generally show that much of the modern tectonic activity is related to transfer of plate-boundary deformation across the country. The left-lateral, strike-slip Chaman fault in southeastern Afghanistan probably has the highest slip rate of any fault in the country; to the north, this slip is distributed onto several fault systems. At the southern margin of the Kabul block, the style of faulting changes from mainly strike-slip motion associated with the boundary between the Indian and Eurasian plates, to transpressional and transtensional faulting. North and northeast of the Kabul block, we recognized a complex pattern of potentially active strike-slip, thrust, and normal faults that form a conjugate shear system in a transpressional region of the Trans-Himalayan orogenic belt.

The general patterns and orientations of faults and the styles of deformation that we interpret from the imagery are consistent with the styles of faulting determined from focal mechanisms of historical earthquakes. Northwest-trending strike-slip fault zones are cut and displaced by younger, southeast-verging thrust faults; these relations define the interaction between northwest-southeast-oriented contraction and northwest-directed extrusion in the western Himalaya, Pamirs, and Hindu Kush regions. Transpression extends into north-central Afghanistan where north-verging contraction along the east-west-trending Alburz-Marmul fault system interacts with northwest-trending strike-slip faults. Pressure ridges related to thrust faulting and extensional basins bounded by normal faults are located at major stepovers in these northwest trending strike-slip systems. In contrast, young faulting in central and western Afghanistan indicates that the deformation is dominated by extension where strike-slip fault zones transition into regions of normal faults. In addition to these initial observations, our digital map and database provide a foundation that can be expanded, complemented, and modified as future investigations provide more detailed information about the location, characteristics, and history of movement on Quaternary faults in Afghanistan.

REFERENCES

Chirico, P.G., and Barrios, Boris, 2005, Void filled SRTM digital elevation model of Afghanistan: U.S. Geological Survey Data Series 130, 1 disc (available at: http://pubs.er.usgs.gov/usgspubs/ds/ds130).

Ruleman, C.A., Crone, A.J., Machette, M.N., Haller, K.M., and Rukstales, K.S., 2007, Map and database of probable and possible Quaternary faults in Afghanistan: U.S. Geological Survey Open-File Report 2007-1103, 39 p., 1pl.

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