Crustal Deformation of 2005 Northern Pakistan Earthquake Detected by SAR (3) Field Investigation and Fault Model

Satoshi Fujiwara[1]; Shinzaburo Ozawa[1]; Hiroshi, P. Sato[1]; Mikio Tobita[1]

[1] GSI

http://vldb.gsi.go.jp/sokuchi/sar/pakistan/pakistan_happyo1111.html

We mapped the crustal deformation of the Northern Pakistan earthquake of 8 October 2005 occurred in the Kashmir region spatially with Synthetic Aperture Radar (SAR) data from the European Space Agency ENVISAT satellite, and found that the area with more than 1-m of observed deformation occupies a ˜90-km long northwest-southwest trending strip-shaped area.

In this presentation, we will show the result of the field investigation and the fault model analysis.

Our field investigation area was mainly along the southern part of the earthquake fault revealed by our SAR analyses. The field investigation route was shown in the figure, from Muzaffarabad to Hatian along Jhelum river valley. The area which crosses the earthquake fault obviously has large damages in roads and buildings. Cracks on soil surface also concentrated in the area close to the earthquake fault. In general it is difficult to distinguish cracks directly related to the earthquake fault from other cracks, for example formed by gravitation; however, using the deformation map detected by SAR we can easily tell them.

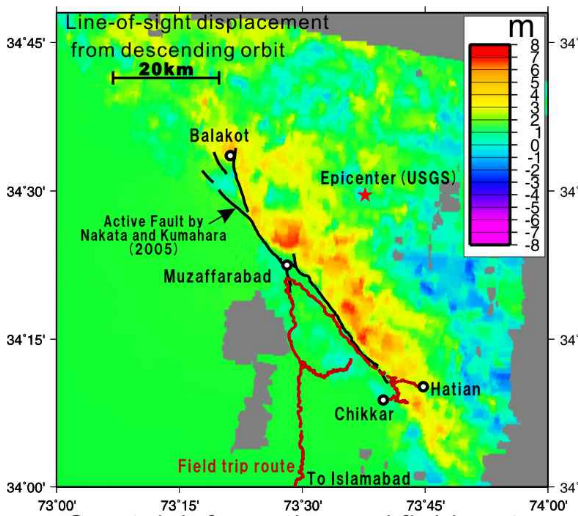
A fault model was constructed to simulate the surface displacement. We used a buried fault model in a homogeneous elastic half-space, as formulated by Okada [1985]. We divided the model fault into three rectangular faults on which slip is uniform. Optimal fault parameters were estimated using an iterative least squares method. The estimated parameters are listed in Table 1 and positions of each fault plane are shown in the figure. The calculated moment magnitude is 7.6 (USGS magnitude is also 7.6).

To estimate the position of the shallow side of the buried faults, we calculated the surface displacement gradient [Fujiwara et al., 2000] in the northeast-southwest direction. The large gradient area clearly coincides with the known active faults. Therefore, this earthquake is considered to be generated by the movement on these preexisting active faults. Additionally, it shows the fault movement occurred also in the southern extension of these active faults.

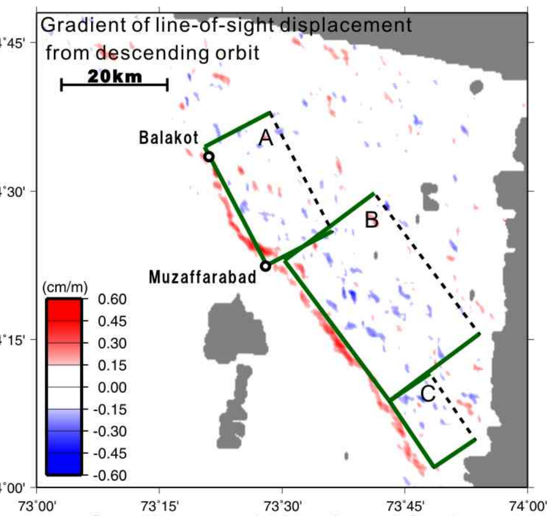
Although there is a small discrepancy between the position of the shallow side of the simulated faults and the area of the large displacement gradient, each extension of the buried shallow side to the surface generally agrees with the large gradient area. The rupture of northern fault plane A approached closer to the surface than those of southern B and C.

Table 1 Fault model parameter

	lat. (deg)	lon. (deg)	depth (km)	length (km)	width (km)	strike (deg)	dip (deg)	rake (deg)	slip (m)
A	34.375	73.469	0.3	25	17	332	38	104	6.0
B	34.146	73.719	1.5	32	22	323	16	92	8.6
C	34.034	73.810	1.5	15	11	325	33	103	2.2



Crustal deformation and field route



Gradient and simulated faults