The M_W=8.1 Antofagasta (North Chile) Earthquake of July 30, 1995: First results from teleseismic and geodetic data.

J.C. RUEGG[1], R. ARMIJO[1], J. CAMPOS[2], S. BARRIENTOS[2]
and french-chilean team for the study of the seismic cycle(*) :

(1) Institut de Physique du Globe, 4 place Jussieu , 75252 Paris cedex 05 Paris, France
(2) Universidad de Chile, Santiago, Chile

KEY WORDS: seismic cycle, North Chile, GPS, deformation models

A strong earthquake Mw = 8.1 occurred on July 30, 1995 in Antofagasta (Northern Chile). This is one of the largest events during this century in the region, where the historical record contains a sequence of two great subduction earthquakes (M = 8.5 - 9) in 1868 (Southern Perú) and 1877 (Northern Chile). The 1995 earthquake ruptured the southernmost portion of a seismic gap in Northern Chile, between 18°S and 25°S, a region that we had already selected as a target for a study of the seismic cycle and a search for seismic precursors. The project included a GPS network with about 50 bench marks covering a region nearly 500 km long (N-S) and 200 km wide (E-W). Fourteen of these marks were re-surveyed with GPS after the 1995 earthquake during a ten day period (August 12 to 22) to characterize the deformation. Comparison with 1992 positions indicate relative horizontal displacement of the coastal bench marks towards the trench of the order of 0.7 m. Bench marks located inland subsided several tens of cm. The bench mark located in Mejillones Peninsula was uplifted by more than 15 cm. Teleseismic body wave modelling of VBB records gives a focal mechanism with N8°E strike, 19° dip, and 110° rake. The source time function shows three distinct episodes of moment release. There is southward directivity with average rupture velocity of 3.3 km s^{-1}. Modelling the displacement field using a dislocation with uniform slip in elastic half-space suggests a rupture zone extending to a depth no greater than 50 km with N-S length of ~180 km and an average slip of ~5 m.; in close agreement with the body-wave model and with the interplate thrust geometry. The observed component of right-slip does not require slip partitioning at the plate boundary. Normal faulting along the Coastal Scarp is likely to accommodate interseismic deformation. That the well-constrained northern end of the 1995 rupture zone is under the southern part of the Mejillones Peninsula increases the probability for a next rupture in the gap north of it.

(*) French-chilean team for the study of the seismic cycle : R. Armijo, P. Briole, H. Lyon-Caen, J.C. Rossignol, J.C. Ruegg, *Institut de Physique du Globe, Paris, France*; T. Duquesnoy, *IGN, St Mandé, France;* L. Ortlieb, *ORSTOM, Paris, France & Antofagasta, Chile,* S. Barrientos, J. Campos, R. Thiele: *Universidad de Chile, Santiago, Chile*; M. Arancibia, J. Cañuta, *SERNAGEOMIN, Santiago, Chile*; D. Lazo , L. Serrurier: *Universidad Arturo Prat, Iquique, Chile*; M. Chang, *IGP, Lima, Peru.*

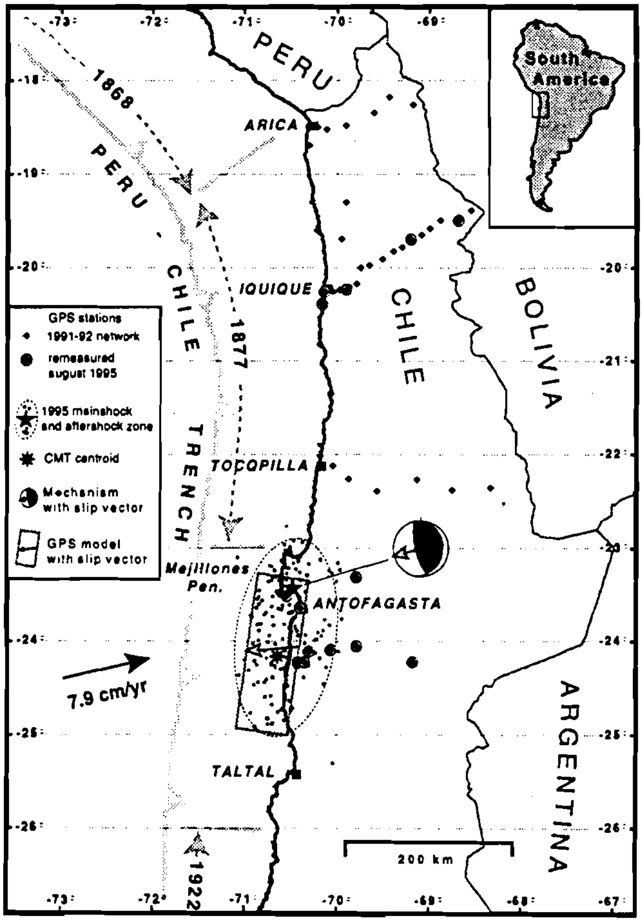

Figure 1 : Subduction segments and seismic gap in Northern Chile, GPS network,, aftershocks and models for the 1995 Antofagasta earthquake. Plate convergence (7.9 cm/yr) from De Mets et al.(1990).

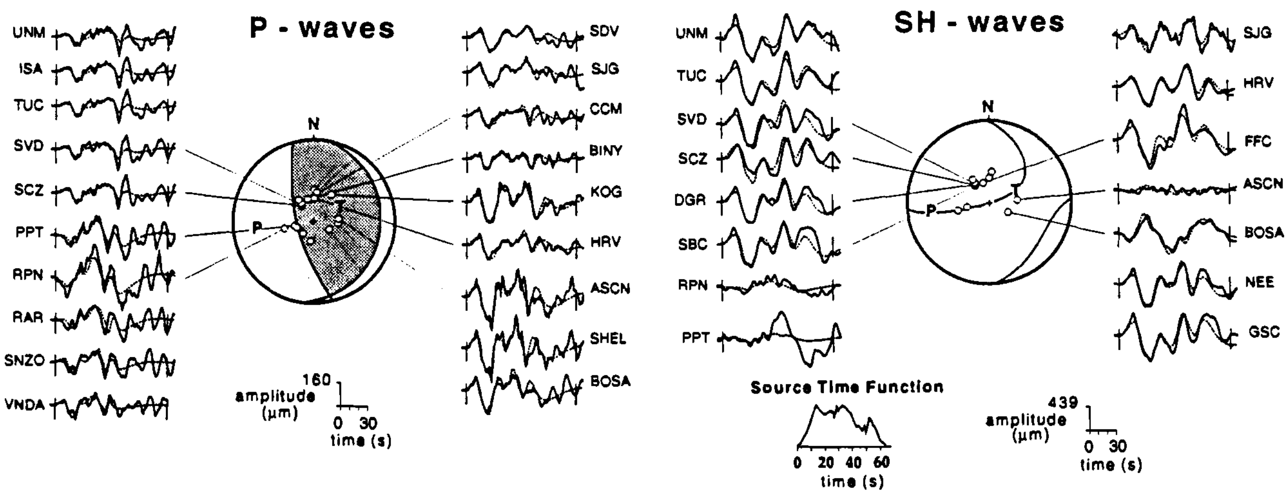

Figure 2 : Average fault plane solution corresponding with the 3 point sources model used in the inversion and corresponding observed and synthetic body wave band pass filtered displacements.

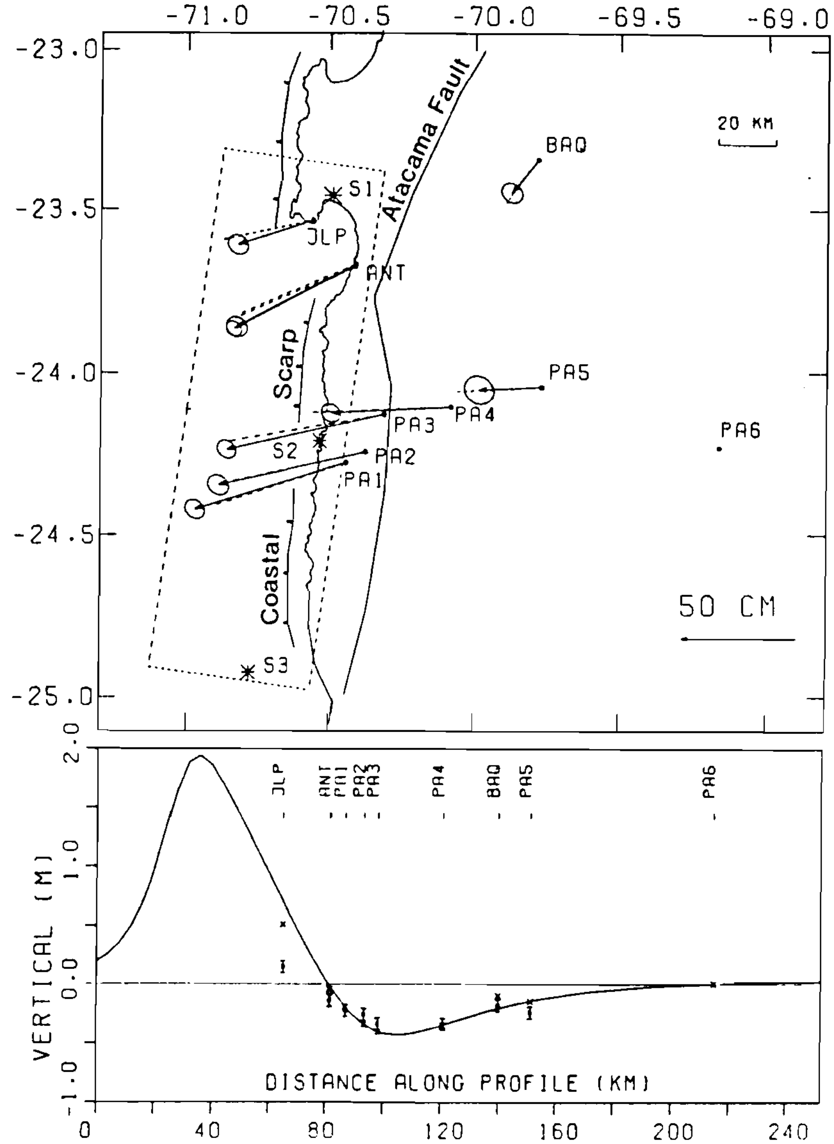

Figure 3 : Uniform slip model based on GPS measurements. Observed and modelled values : (a) Fit to horizontal displacements with 19° dip (solid arrows with 95% confidence ellipses: observed; dashed : modelled) . S1, S2, S3 are the three point sources from body waves modelling. Fit to vertical displacements with 24°dip (squares with error bars, observed; crosses, modelled; curve, modelled across AB section).

REFERENCES

Armijo R. and R. Thiele, Active faulting in Northern Chile: ramp stacking and lateral decoupling along a subduction plate boundary, *Earth Planet Sci. Lett., 98*, 40-61, 1990.

Comte, D. and M. Pardo, Reappraisal of great historical earthquakes in the Northern Chile and souther Peru seismic gaps, *Natural Hazards, 4*, 23-44, 1991.

DeMets, C., R.G. Gordon, D.F. Argus and S. Stein, Current plate motions, *Geophys. J. Int., 101*, 425-478, 1990.

Monfret T., L. Dorbath, J.P. Caminade, M. Pardo, D. Comte, J. Thomas, A. Cisternas, B. Dellouis and L. Rivera, The July 30, 1995 Antofagasta earthquake: an "hypocritical" seismic event, *EOS Trans. AGU 76 (46)*, 375, 1995.

Ortlieb, L., S. Barrientos, A. Lavenu and T. Montfret, Coseismic uplift motion near Antofagasta, N Chile, related to the July 30, 1995, Ms=7.3 event: first field evidence from the intertidal area, *EOS Trans. AGU 76 (46)*,427, 1995.

Ruegg, J.C., J. Campos, R. Armijo, S. Barrientos et al., The M_W=8.1 Antofagasta (North Chile) Earthquake of July 30, 1995: First results from teleseismic and geodetic data, Geophys. Res. Letters (in press), 1996.
