Seismic Imaging across the Moroccan Atlas (SIMA): An effort to constrain the crustal structure and topography of the Atlas Mountains

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The Atlas Mountains are a young intra-continental Cenozoic orogenic belt located at the southern edge of the diffuse plate boundary zone separating Africa and Europe. The Atlas features a high topography that locally exceeds 4000 m. However, geological and preliminary geophysical studies suggest that it has experienced less than 25% of shortening and moderate crustal thickening. These observations rise the question of the origin of the Atlas high elevation. Potential field geophysical studies and previous low-resolution refraction experiments report a maximum crustal thickness of ~40 km, suggesting that the range is out of isostatic equilibrium at a crustal level and that an asthenospheric upwelling is needed to support the mountain load. These models, however, lack the constraints that would provide the knowledge of the precise Moho depth.

In order to fulfill this requirement and to constrain the seismic velocity structure of this mountain system, a 700 km long, seismic wide-angle reflection and refraction transect has been recently acquired by an international team. The north-south transect extends from the Sahara Desert south of Merzouga, to Ceuta at the Gibraltar arc, crossing the High and Middle Atlas and the Rif mountains. Seismic energy released at 6 shot points generated by the detonation of 1 TN of explosives was recorded by ~ 900 Reftek-125a seismic recorders from the IRIS-PASSCAL pool. Seismic stations were deployed with an average spacing of 650-750 m. The 6 shot points were located within the southern part of the transect with a shot spacing of ~60-70 km.

Preliminary analysis of data shows an uneven distribution of the energy, providing a poor signal/ratio relation at longest offsets, thus hindering the identification of the deepest phases. However, crustal phases (Pg and PiP) and mantle reflected/refracted phases (PmP and Pn) are present in most of the shot gathers. Preliminary modelling of these phases leads to an estimation of the changes in the Moho topography along the Atlas Mountains but provides little information about the Rif. A second experiment aimed to sample in detail the Rif is planned for late 2011.