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Geodetic networks in Al-Hoceima, Fez-Meknes and Ouarzazate regions (Morocco) to monitor local deformations

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In the framework of some interdisciplinary research projects, several geodetic studies have been initiated aiming to quantify ground deformation in some areas of Morocco: the Al-Hoceima region (Rif cordillera), the Fez-Meknes region and the Ouarzazate region (Atlas Mountains).
The Al-Hoceima region, located in the central part of the Rif Cordilleras, has undergone an intense seismic activity, in which the most significant events occurred in 1994 and 2004 (M= 6.3). Although seismicity data support the presence of transcurrent faults, and available radar interferometry researches evidence surface deformations, geological data suggest that main seismogentic fault zone has not a surface expression. Anyway, a set of N-S oriented normal faults (Rouadi, Al-Hoceima, Trougout) determines the present-day geomorphology and seems to continue to be active in surface. In this area, a new non-permanent GPS network consisting of 6 sites has been installed and surveyed in June 2007 and September 2008. The repeated measurements of this network may allow to exactly determine the surface expression of deep tectonic deformations in this region, and to quantify the creep and the coseismic motions in the area, that will contribute to better understand the seismic hazard.
The Prerif Ridges located in the Fez-Meknes region, constitute the active mountain front of the Rif cordillera that accommodates most of the recent convergence between Eurasia and African plates. South of the ridges, the Saïss foreland basin overlies the foreland rocks corresponding to the Middle Atlas. There are evidences of Quaternary uplift of the Prerif Ridges and deformation of recent sediments as consequence of the southwards propagation of reverse faults along the mountain front. In addition, the foreland basin undergoes a roughly N-S extensional regime. The region undergoes a moderate seismic activity, with catastrophic events like that occurred in 1755 which damaged Fez and Meknes. On September 2007, a non-permanent GPS network was installed and surveyed for the first time. The aim of this one is to characterize the activity of the mountain front, with related uplift and contractional structures, and its propagation to the foreland. The determination of the creep and seismic slip along the main faults may help to constraint the seismic hazard of the region.
The Atlas Mountains of Morocco have been the target of several geophysical studies: gravity, refraction and Magnetotellurics surveys carried out during the 80's and 90's have helped to establish some of the main characteristics of this intracontinental orogen, such as its overall structure and modest crustal thickness. Later studies, based on structural geology, higher resolution gravity surveying and multidisciplinary potential field modelling indicated that the High Atlas crust is too thin to support its topography and that a mantle contribution is required. An astenospheric upwelling, which triggered the Eocene-to-recent Atlas magmatic activity was then proposed as the main cause of its topography. Crustal thickness happens to be the key to establish the position of the lithosphere-astenosphere boundary and therefore, to asses the real contribution of the mantle to the topography and accordingly the actual uplift. Finally, a non-permanent GPS network has been established around the Ouarzazate Basin and surveyed for the first time in September 2007. This network is aimed to control the recent vertical and horizontal movements that affect the area in an attempt to constrain the current deformation rates in the Atlas system.
This paper describes the geodynamic context of these areas and the geodetic studies that are being carried out.