Geophysical Research Abstracts
Vol. 18, EGU2016-11496, 2016
EGU General Assembly 2016

Elastic structure and seismicity of Donegal (Ireland): insights from passive seismic analysis

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Ireland's crust is the result of a complex geological history, which began in the Palaeozoic with the oblique closure of the Iapetus Ocean and, probably, it is still on-going. In the northwestern portion of the island, the geology of Donegal has been the subject of detailed geological investigation by many workers in the last century. The most widely represented rock types in Donegal are metasediments of Dalradian and Moinian age, invaded by several granites of Caledonian age (so called Donegal granite). Smaller and separate intrusions are present (e.g. Fanad Head). On the contrary, it is widely accepted that the the deep crustal structure of the northern portion of Ireland has been re-worked in more recent time. The several phases of lithospheric stretching associated to the opening of the Atlantic ocean interested such portion of Ireland, with the extrusion of flood basalts. Moreover, the presence of a hot, low-density asthenospheric plume spreading from Iceland has been suggested, with the formation of a thick high-velocity layer of magmatic underplated material at the base of the crust. Oddly, at present, Donegal is the only seismically active area in Ireland, with an average rate of one Mw=2-3 event every 3-4 years.

In the last three years, passive seismic data have been recorded at 12 seismic stations deployed across the most seismically active area in Co. Donegal, with the aim of reconstructing the seismic structure down to the upper-mantle depth and of locating the microseismic activity within investigating volume. Both local and teleseismic events were recorded giving the opportunity of integrating results form different techniques for seismic data analysis, and jointly interpret them together with surface geology and mapped fault traces. Local events have been used to define constrain faulting volumes, focal mechanisms and to reconstruct a low-resolution 3D Vp and VpVs velocity models. Teleseismic events have been used to compute receiver function data-set for each station. RF data-set have been used to reconstruct S-wave velocity structure both in the shallow and deep crust, and to highlight the presence of anisotropic volumes at depth.