Interplate seismicity at the CRISP site: the 2002 Osa earthquake sequence

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The Costa Rica Seismogenesis Project (CRISP) is designed to explore the processes involved in the nucleation of large interplate earthquakes in erosional subduction zones. On 16 June 2002 a magnitude Mw=6.4 earthquake and its aftershocks may have nucleated at the subduction thrust to be penetrated and sampled by CRISP, ~40 km west of Osa Peninsula.

Global event locations present uncertainties too large to prove that the event actually occurred at a location and depth reachable by riser drilling. We have compiled a database including foreshocks, the main shock, and ~400 aftershocks, with phase arrival times from all the seismological networks that recorded the 2002 Osa sequence locally. This includes a temporal network of ocean-bottom hydrophones (OBH) that happened to be installed close to the area at the time of the earthquake. The coverage increase provided by the OBH network allow us to better constrain the event relocations, and to further analyze the seismicity in the vicinity of Osa for the six months during which they were deployed. Moreover, we undertook teleseismic waveform inversion to provide additional constraints for the centroid depth of the 2002 Osa earthquake, allowing further study of the focal mechanism.

Along the Costa Rican seismogenic zone, the 2002 Osa sequence is the most recent. It nucleated in the SE region of the forearc where this erosional margin is underthrust by a seamount covered ocean plate. A Mw=6.9 earthquake sequence occurred in 1999, co-located with a subducted ridge and associated seamounts. The Osa mainshock and first hours of aftershocks began in the CRISP area, ~30 km seaward of the 1999 sequence. In the following two weeks, subsequent aftershocks migrated into the 1999 aftershock area and also clustered in an area updip from it. The Osa updip seismicity apparently occurred where interplate temperatures are ~100°C or less.

In this study, we present the relocation of the 2002 Osa earthquake sequence and background seismicity using different techniques and a moment tensor inversion for the mainshock, and discuss the corresponding uncertainties, in an effort to provide further evidence that the planned Phase B of CRISP will be successful in drilling the seismogenic coupling zone.