Geophysical Research Abstracts
Vol. 20, EGU2018-2345, 2018
EGU General Assembly 2018

Illustration and quantification of the erosion of the Himalaya mountains using the tectonic setting of Expedition 362 (Sumatra Seismogenic zone)

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In 2004, a magnitude >9 earthquake struck North Sumatra and the Andaman-Nicobar islands leading to a huge tsunami. In order to find some explanation to this event, Expedition 362 (August- September 2016) drilled sites U1480 (until 1432 m below the seafloor) and U1481 (until 1500 m below the seafloor) on a section of the seafloor ∼200 km west of Sumatra, before the Indian Plate reaches the Sunda subduction zone. What makes the subduction zone offshore Northern Sumatra quite unusual is the amount of sediment on the subducting oceanic plate (up to 5 km thick just before subduction).
Geologists have determined that the sedimentary materials being incorporated into the North Sumatra subduction zone are related to the Bengal-Nicobar Fan system, which originates more than 3000 km away from our drilling site! This fan is the largest submarine fan currently on the planet. This sedimentary system originates from erosion of the Himalayan mountains. Rivers carry the eroded material to the coast. Most of the sediment (∼80%) is deposited onshore and offshore quite close to the coastline. But a huge amount still makes its way along deep-sea canyons to the deep sea portion of the Indian and even Australian plate. A lot of turbidites coming from the erosion of the Himalaya mountains have been described on board.
The propose classroom activity use this unusual tectonic setting and aims to highlight the concept of erosion and transport of sediments adjusted to the French high school programs.
The students start from the localization of Expedition 362 with Google Earth Pro and observe some photos of the cores showing turbitides. They realize a smear-slide using analogic sediments such as those described on board. This way, they can find some minerals which characterize plutonic and metamorphic rocks (such as biotite). They also look at the topography of the sea floor using Google Earth Pro and rule the possibility that these turbidites come from the erosion of the Himalaya mountains.
To confirm this idea, they analyze a figure extracted from an article written by the Expedition 362 scientists in 2017*. In this article, the detrital zircons ages of samples of the expedition are plotted and compared to regional rivers (Brahmaputra, Ganges and Irrawaddy) and to regional formations. Students can then conclude that most of the material of sediments found in the turbidites come from the Himalaya mountains. They can also estimate the length of their journey using Google Earth Pro. An analogic modelling of a turbidite flow can be realized in class.
To finish, an estimation of the quantification of erosion from the last 20 My is made by using Google Earth Pro and rates of sedimentation estimated from Expedition 354 data.
Most scholarly books show schematics, models and interpretation and the aim of this classroom activity is to use real data from a recent IODP Expedition to make the students “touch” the science.

* McNeill & al., Earth and Planetary Science Letters, Volume 475, p.134-142