AvH6-13, 2010
6th Alexander von Humboldt International Conference


# Largest natural catastrophes in Holocene and their possible connection with comet-asteroid impacts on the Earth

D. Abbott (1), E. Bryant (2), V. Gusiakov (3), and B. Masse ()

(1) Columbia University, Palisades, USA, (2) University of Wollongong, Wollongong, Australia, (3) Institute of Computational Mathematics and Mathematical Geophusics, Novosibirsk, Russia, (4) Los Alamos National Laboratory, Los Alamos, US

This paper deals with the physical and environmental effects resulting from ocean impacts by sizable comets, and the rates and risks associated with such cosmic impacts. Specifically, we investigate two sets of probable oceanic impact events that occurred within the last 5000 years, one in the Indian Ocean about 2300-2800 BC, and the other in the Gulf of Carpentaria (Northern Australia) in 536 AD. If vali-dated, they would be the most energetic natural catastrophes occurring during the middle-to-late Holocene with large-scale environmental and historical human effects and consequences. The physical evidence for these two impact events consists of following sets of data: (1) remarkable depositional traces of coastal flooding in dunes (chevron dunes) found in southern Madagascar and along the coast of the Gulf of Carpentaria, (2) the presence of crater candidates (29-km Burckle crater about 1500 km southeast of Madagascar which dates to within the last 6000 years and 18-km Kanmare and 12-km Tabban craters with an estimated C14 age of 572$\pm$86 AD in the southeast corner of the Gulf of Carpentaria), and (3) the presence of high magnetic susceptibility, quench textured magnetite spherules and nearly pure carbon spherules, teardrop-shaped tektites with a trail of ablation, and a vitreous material found by cutting-edge laboratory analytical techniques in the upper-most layer of core samples close to the crater candidates.

V-shaped chevron dunes were first described as a wind-blown formation by Maxwell and Haynes (1989) in south-western Egypt and the northern Sudan, where they consist of sinuous, parallel, blade-shaped deposits of sand, 10-30 cm high and 0.13-1.2 km in length. Later they were found widely distributed along many parts of the World Ocean coastline and especially well-developed around the Indian Ocean coastline and in the Gulf of Carpentaria. Although some propose a wind-blown ori-gin for all coastal chevron dunes, we have evidence in favor of their mega-tsunami formation. In southern Madagascar we have documented evidence for tsunami wave run-up reaching 205 m above the sea-level and penetrating up to 45 km inland along the strike of the chevron axis. The orientation of the dunes is not aligned to the dominant wind direction, but to the path of refracted mega-tsunami originating from the Burckle crater candidate area.

The Carpentaria crater candidates have several lines of evidence in favor of their bolide impact origin. The first is their overall morphology derived from satel-lite altimetry. The second is the occurrence of clear terrestrial impact ejecta in the form of impact spherules and a vitreous material. The impact spherules are mostly iron oxide but a few silicate spherules and pure carbon spherules are also present. We have found iron oxide spherules with quench textures melting out of rocks that contain fossils, barite, and siderite. This allows us to rule out an origin for the iron spherules as ablation spherules derived from meteorites. The impact ejecta occur as a well defined, $\sim$1 cm thick layer in three piston cores and has an age of about 1500 BP. The third line of evidence is that the local chevrons all have back azimuths that point towards the locations of the crater candidates. The chevron orientations do not precisely match the direction of the prevailing wind. Finally, some chevrons contain 10 cm thick lag deposits of shell, and are locally absent where the coast is shielded by flat, off shore islands.

The results of our study show that the substantive oceanic comet impacts not only have occurred more recently than modeled by astrophysicists, but also that they have profoundly affected the Earth's natural systems, climate, and human societies. It can potentially lead to a major paradigm shift in environmental science by recog-nizing the role of oceanic impacts in major climate downturns during the middle-to-late Holocene that have already been well documented by using different techniques (tree-ring anomalies, ice-, lake- and peat bog-cores).