Establishing the first continuous Holocene tephr stratigraphy on Kerguelen Archipelago, subantarctic Indian Ocean

Fabien Arnaud¹, Pierre Sabatier¹, Anouk Leloup¹, Aymeric Servettaz¹², Bertrand Moine³, Anne-Lise Develle¹, Stéphane Guedron⁴, Vincent Perrot⁵, Jérôme Poulenard¹, Bernard Fanget¹, Emmanuel Malet¹, Eivind Støren⁵, Jean-Louis Reyss¹, Nicolas Le Viavan⁶, Katrien Heirman⁷, Marc De Batist⁷, Elisabeth Michel², Jacques-Louis de Beaulieu⁸, Nathalie Vanderputten², and Jostein Bakke⁵

¹Environment Dynamics and Territories of the Mountains (EDYTEM), Université Savoie Mont-Blanc, CNRS, 73000 Chambéry, France
²Laboratoire des Sciences du Climat et de l’Environnement (LSCE), CEA, CNRS, 91 Gif-sur-Yvette, France
³Laboratoire Magmas et Volcans, Université Jean Monnet, CNRS, 42023 Saint-Etienne France
⁴Institut des Sciences de la Terre (ISTerre), Université Grenoble Alpes, CNRS, Grenoble, France
⁵Department of Earth Science and Bjerknes Centre for Climate Research, University of Bergen, Allégaten 41, 5007 Bergen, Norway
⁶Institut Paul-Emile Victor (IPEV), 29280, Plouzané, France
⁷Renard Centre of Marine Geology, Department of Geology and Soil Sciences, Ghent University, Krijgslaan 281 S8, B-9000 Ghent, Belgium
⁸Institut Méditerranéen de Biodiversité et d’Ecologie marine et occidentale (IMBE), Aix-Marseille Université, CNRS, 13545 Aix en Provence, France

Here we present the first Holocene-long continuous chronology of volcanic eruptions on Kerguelen archipelago, where no evidence of Holocene volcanic activity has been published so far. Our chronicle is based upon sedimentological, chronological and geochemical data from two sediment cores, taken in two different depocenters of a large lake, Lake Armor, located ca. 70 km away from the archipelago’s potentially active volcanic area. This allowed us to confidently attribute the origin of pumice-rich or ash-rich layers to contemporaneous volcanic eruptions. Altogether eight main eruptions, as well as three secondary ones, were here documented and dated, among which the youngest occurred during the Middle Age, between 890 and 980 AD. The oldest eruption is also by far the strongest one and deposited more than 1.2m of up-to 3cm large pumices, 70 km away from the volcanic edifice. It occurred at the very beginning of the Holocene (11 ka cal. BP), suggesting a climatic control after glacial retreat upon volcanic activity. Additional evidences from lake sediment and geological outcrops, both close to Lake Armor and in remote areas over Kerguelen mainland, open the future possibility of a better reconstruction of major eruptions deposit spreading and thus an assessment of their intensity. This established chronostratigraphy will be useful to synchronise paleoenvironment record at least at the scale of the archipelago as well as in surrounding marine areas where Holocene climate reconstructions are particularly sparse.