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Extensive lake sediment coring survey on Sub-Antarctic Indian Ocean Kerguelen Archipelago (French Austral and Antarctic Lands)

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Recent paleo-studies revealed climatic southern high latitude climate evolution patterns that are crucial to understand the global climate evolution(1,2). Among others the strength and north-south shifts of westerlies wind appeared to be a key parameter(3). However, virtually no lands are located south of the 45th South parallel between Southern Georgia (60°W) and New Zealand (170°E) precluding the establishment of paleoclimate records of past westerlies dynamics. Located around 50°S and 70°E, lost in the middle of the sub-Antarctic Indian Ocean, Kerguelen archipelago is a major, geomorphologically complex, land-mass that is covered by hundreds lakes of various sizes. It hence offers a unique opportunity to reconstruct past climate and environment dynamics in a region where virtually nothing is known about it, except the remarkable recent reconstructions based on a Lateglacial peatbog sequence(4).

During the 2014-2015 austral summer, a French-Norwegian team led the very first extensive lake sediment coring survey on Kerguelen Archipelago under the umbrella of the PALAS program supported by the French Polar Institute (IPEV). Two main areas were investigated: i) the southwest of the mainland, so-called Golfe du Morbihan, where glaciers are currently absent and ii) the northernmost Kerguelen mainland peninsula so-called Loranchet, where cirque glaciers are still present. This double-target strategy aims at reconstructing various independent indirect records of precipitation (glacier advance, flood dynamics) and wind speed (marine spray chemical species, wind-borne terrigenous input) to tackle the Holocene climate variability.

Despite particularly harsh climate conditions and difficult logistics matters, we were able to core 6 lake sediment sites: 5 in Golfe du Morbihan and one in Loranchet peninsula. Among them two sequences taken in the 4km-long Lake Armor using a UWITEC re-entry piston coring system by 20 and 100m water-depth (6 and 7m-long, respectively). One sequence from the newly-named Lake Tiercelin (2m-long) was recovered using UWITEC gravity coring equipment operated from a portable rubber boat by 54m water-depth. Those three sequences cover the whole Holocene periods. The 3m-long sequence taken in Lake Guynemer, Loranchet peninsula, was taken using a homemade small platform and a Nesje piston corer by 50m water-depth and covers the last 5 ka cal. BP. Two additional lakes were cored in the vicinity of Lake Armor: Fougères and Poule from which short sequences were taken in order to study environmental changes since the arrival of humans in the 18th century and the subsequent introduction of exogenous plant and animal species.

We present here preliminary results including the dating of all sediment sequences as well as their chemical logging and sedimentological description. This already revealed the recurrence of Holocene volcanic eruptions as well as erosion patterns that are comparable among different records. The recognition of tephra layers will further allow the synchronization of terrestrial records together and with marine records around Kerguelen Archipelago. Paleoclimate interpretations of acquired data as well as further measurements are still ongoing processes. However, one may already argue that we collected rare geological sequences of prime importance in the quest of understanding climate patterns affecting the southern high latitudes all along the Holocene.

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