A ~6 MA LONG RECORD OF MAJOR EXPLOSIVE ERUPTIONS FROM THE KURILE-KAMCHATKA ARC

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One of the prerequisites of predicting future giant eruptions is the understanding of sizes and recurrence times of past similar events. At the same time, the global record of the large eruptions remains incomplete even for the last millennia and deteriorates deeper in time as many eruptions are yet to be identified (Rougier et al., 2016a; 2018). This is particularly true for the remote and highly explosive North Pacific volcanic arcs potentially hazardous for the Northern Hemisphere. One of these arcs is the Kurile-Kamchatka volcanic chain where only Holocene explosive eruptions have been studied in detail (e.g., Braitseva et al., 1995, 1996, 1997; Ponomareva et al., 2004, 2013a, 2015) while the Pleistocene record remains obscure and is dotted with only a few dated events (Braitseva et al., 1995; Bindeman et al., 2010; Ponomareva et al., 2013b). Holocene ultra-distal tephras from Kamchatka were found as far as Greenland (Cook et al., 2018) and Svalbard (van der Bilt et al., 2017) that attests to the hemispheric impact of the Kamchatka eruptions. Kamchatka also has the highest concentration of Quaternary calderas per unit of arc length in the world (Hughes and Mahood, 2008); more of that, many calderas are nested so the number of caldera-forming eruptions is definitely larger than that of the morphologically expressed calderas (e.g., Seligman et al., 2014).

Marine sediments around Kamchatka contain numerous tephra layers suggesting eruptions of magnitude (M) ≥6, similar or larger than the 1883 Krakatau eruption. Our current research is aimed at the reconstruction of the continuous ~6 Ma record of tephra layers based on the Ocean Drilling Program cores taken in 1992 in NW Pacific, ~700 km downwind from Kamchatka and Northern Kurile Islands during the cruise of the R/V JOIDES Resolution (Rea et al., 1993) (Fig. 1). In addition, we use MD01-2415 and -2416 cores retrieved in 2001 during the WEPAMA cruise of the R/V Marion Dufresne in the frames of the IMAGES program (Holbourn et al., 2002).

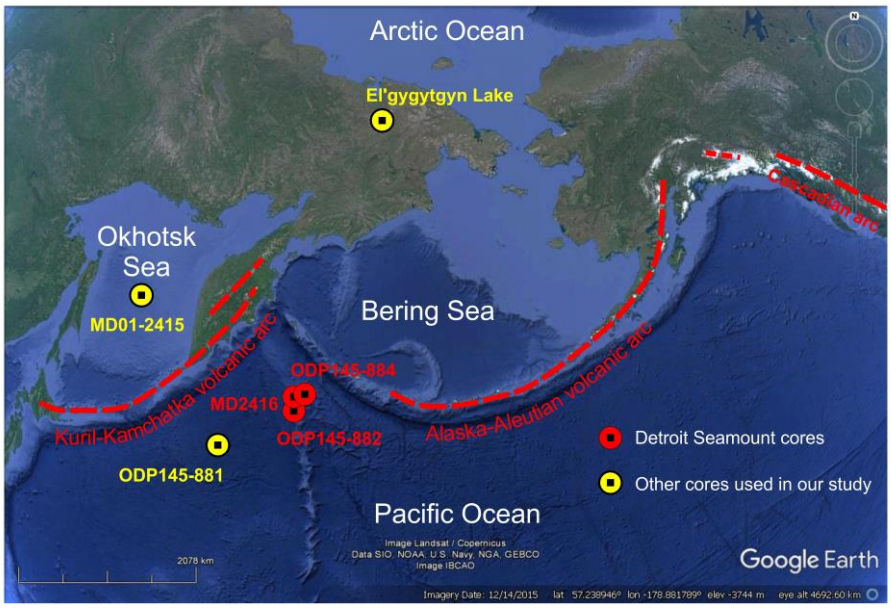

Fig. 1. Location of the cores used in this study

As a first step of our research, we are presenting a summary sequence of 109 unique tephra layers buried in the Detroit Seamount sediments (NW Pacific) during the last ~6 Ma. The summary is based on tephra correlations among three sediment cores: ODP145-882 and 884 (both ~6 Ma), and MD01-2416 (~1 Ma) (Fig. 1). All tephra layers were geochemically fingerprinted with the help of single-shard electron microprobe analysis (4288 individual points). In addition, all tephras from ODP145-882 and selected tephras from ODP145-884 were analyzed with the help of single-shard LA-ICP-MS analysis (597 points). Twelve tephra layers from those deposited within the last 1 Ma were found in all the three cores. Additionally, twenty one tephra layers were found in two cores. Other layers were well expressed only in one of the cores. Geochemical correlations of tephra layers among the three cores have permitted the construction of the summary tephra sequence, which allows us to combine individual age-depth models for each site into the integral and consistent age model, and in this way to refine the ages of individual eruptions.

At this stage, we were able to identify sources for 16 tephra layers, including tephra layer related to the Pauzhetka caldera and eight layers associated with the Gorely eruptive center in South Kamchatka. Seventeen tephra layers were correlated to their proximal or distal counterparts, which had been dated elsewhere. For example, two of the tephra layers in the Detroit Seamount sediments are also present in the El'gygytgyn Lake core taken in 2009 within the frames of the International Continental Scientific Drilling Program (Fig. 1). Tephra correlations have allowed us to identify dispersal areas for a number of the largest eruptions. The Detroit sequence of geochemically characterized tephra layers obtained downwind from the Kurile-Kamchatka arc is the first ever record of the largest explosive eruptions in the region for the last 6 Ma. In addition, it can serve as a reference for regional and even hemispheric tephra correlations among disparate paleoenvironmental archives.

Research on tephras buried in marine deposits is an effective method of identification of the largest eruptions and reconstruction of their parameters. Our studies will serve as a prerequisite of the understanding of sizes and recurrence times of past large eruptions, which in turn will permit the identification of space-time patterns in the volcanic activity and long-term forecast of the future large events.

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