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Volcanic source-to-sink: stratigraphy and chronology of lahar deposits in a volcanic fan-delta-lake system, Adatara and Bandai volcanoes, NE Japan

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Adatara and Bandai volcanoes in the northeast Japan are representative active volcanoes very close to each other (~18 km); the latter is well known by a large-scale debris avalanche following a phreatic eruption in AD1888 that took more than 400 fatalities. The known eruptive history of Adatara volcano comprises 6 Vulcanian and 5 phreatic eruptions during the last 10,000 years [1]. The most recent eruption occurred in AD1889-1900. In the Sukawa River system, western slope of Adatara volcano, there are 17 muddy lahar (cohesive debris flow) units and one bouldery unit (cohesionless debris flow or crater-lake outburst flood origin) that were formed during the last 14,000 years [2]. The lahar units are characterised by muddy matrix-rich facies and are very poorly sorted with pebble to cobble sized andesite clasts and hydrothermally altered clasts.

The Nagasegawa River, sourced from Bandai volcano, joins the Sukawa River before debouching into Lake Inawashiro-ko and forms a delta at the mouth. Sedimentary cores drilled on the deltaic area (KBR2015) and lake floor (INW2012, 2013) revealed a number of intercalations of muddy units. At least 9 muddy units in the INW2012 core above the 17 ka (As-K tephra) horizon, 22 muddy units in the INW2013-st2 above the 5.4 ka (Numazawa-ko tephra) horizon and 24 units in INW2013-st3 since 11 ka (^{14}C age), are present; all of these are deposited in offshore environments. The muddy units are usually mms to cms thick, blue-grey colour, and homogenized to graded, and partly consists of several subunits. Some of these units contain small amount of glass shards, organic material, and fragments of diatoms. The lithology and sedimentary facies are unique and easy to identify amongst the varve-like laminated background lake sediments. In the KBR2015 core, 5 muddy units, deposited after 18 ka, are found. One of the units is 45 cm thick, moderately sorted, and blue-grey muddy matrix-rich facies with very coarse sand to granule grains partly composed of hydrothermally altered lithic fragments. The deposit is inversely graded at the base and then fines upwards. Bulk chemistry by XRF and micro-XRF of these muddy units in proximal (Sukawa River), medial (delta) to distal (lake floor) areas indicates high sulfur contents of the sediments partly derived from pyrites in the matrix.

By the lithology, sedimentary facies, and chemical composition, we consider that these muddy units found in proximal to distal areas are derived from a single origin; muddy lahars (cohesive debris flows/mudflows) from Adatara and/or Bandai volcanoes that travelled a long distance (~30 km). High-sulfur contents indicate syn- or post-eruptive lahars in relations with phreatic eruptions or degradation of hydrothermally altered source rocks nearby the craters of volcanoes. More frequent intercalations of lahar deposits than those of known eruptive deposits suggest that the presence of unknown eruptions of the two volcanoes causing the lahars after the eruptions. Phreatic eruptions tend to be small scale comparing to magmatic eruptions, and therefore traces of these eruptives are limited in proximal

(summit) areas and are prone to be degraded soon after the deposition. Ages of these frequent eruptions also cannot be easily determined because of lack of vegetation in summit areas that can provide ^{14}C ages for eruptions. Therefore, examination of lahar deposits in the distal tract must be important not only to unravel a lahar history but also to evaluate the frequency of small-scale eruptions, which are otherwise unaccounted for, as appropriate volcanic risk assessments for Inawashiro Town (15,000 population) located at the foot/downstream of the volcanoes.

References:

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