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AN UP-TO-DATE HOLOCENE CATALOG OF SEDIMENTARY EVENTS RECORDED IN VOLCANIC LAKES FROM THE FRENCH MASSIF CENTRAL

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INTRO

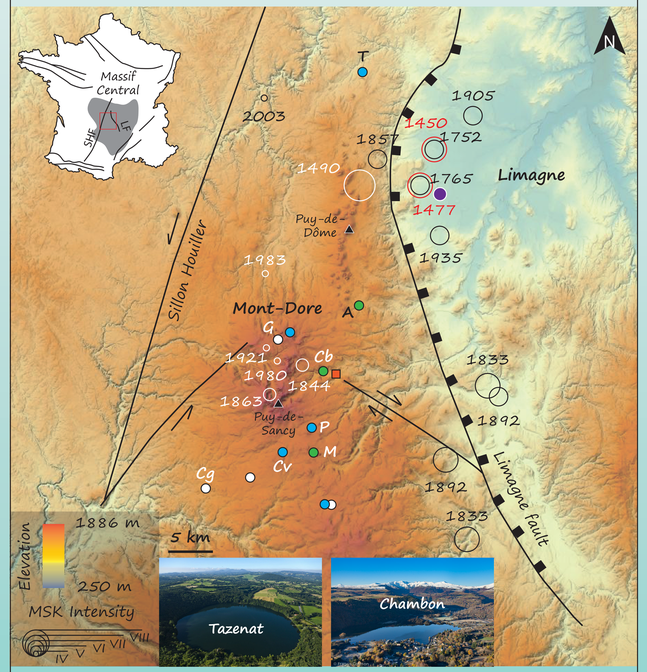
A decade of scientific investigation, combining high-resolution hydro-acoustic profiles and multi-proxy analyses of sediment cores, highlighted several sedimentary events in lakes from volcanic areas across the French Massif Central (FMC). This low to medium seismogenic area is located along the Limagne fault where strong earthquakes occurred in the past (epicentral MSK intensity IV-VIII), but historical data are sparse and geohazards still remain overlooked.

This poster presents new results from recent surveys conducted on small Lake Lacassou, related to the formation of Lake Chambon and northernmost maar lake Gour de Tazenat. These surveys allowed to refine the catalog of sedimentary events that bring insight about the nature, the origin, and the timing of Holocene geohazards, including (1) past earthquakes from co-eval deposits at regional scale; and (2) limnic hazard in Lake Pavin.

Chassiot et al., 2016b

SETTING

SISFRANCE - SHEEC - AHEAD



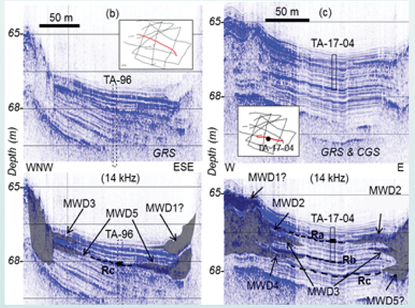
Strike-slip fault
Normal fault

- Murol castle
- Dam lake : A = Aydat ; M = Montcineyre ; Cb = Chambon
- Maar lake : P = Pavin ; Cv = Chauvet ; T = Tazenat
- Glacial lake : G = Guéry - Cg = La Crégut
- Palustrine sequence Gravanches (Grv)

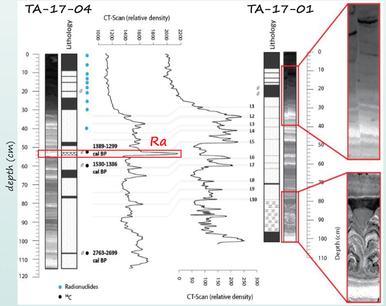
ARCHIVES

TAZENAT

HYDRO-ACOUSTIC IMAGES (14 kHz)



SHORT-CORES (2017)

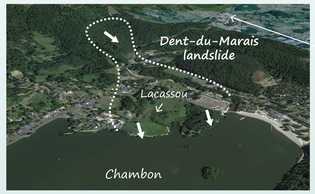


Two acoustic facies can be observed on hydro-acoustic images from Tazenat: (1) downslope transparent and chaotic lenses interpreted as mass-movement deposits (MMD or MWD); (2) laminated facies with high-amplitude reflectors in the deep basin. CT-scan images of short-cores display sandy layers, micro-faulting, and amalgamated MMD. Seismic-to-core correlation match reflector Ra with sandy layer L5 at 53 cm depth in core TA-17-04, interpreted as a distal turbidite. Radiocarbon chronology allows to date this event around AD 610 ± 50 (2θ).

At least five generations of MMD have been observed on Tazenat acoustic images. It is expected that some of them are associated with distal turbidites corresponding to sandy layers evidenced in 1996 and 2017 cores. Tazenat is a promising site for FMC paleoseismological study. Additionnal chronological information are however needed to better constrain the timing and the origin of MMDs.

Juvigné and Stach-Czerniak, 1998

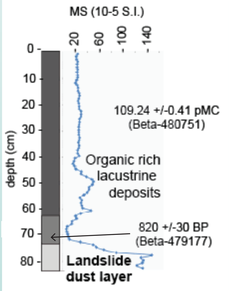
CHAMBON & LACASSOU



Murol Castle
Archeoseismology
Medieval failures

Allios, 2015

LACA17-B

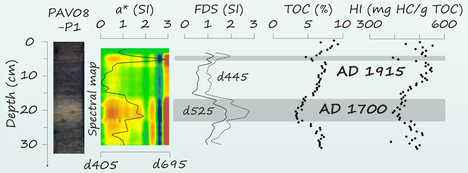


LACA17-B is a 80-cm long core displaying three sedimentary units. Because Lake Lacassou is a small shallow lake formed on the Dent-du-Marais landslide, it is assumed that the dust layer at the bottom of the core is related to the landslide formation.

Radiocarbon age suggests an age of AD 1230 ± 50 (1θ at 97%). This layer, its associated landslide, and the subsequent formation of Lake Chambon may thus be younger than previously reported.

Macaire et al., 1997

LIMNIC HAZARD IN PAVIN ?



Unusual deposits have been identified in cores collected on the plateau (0-45 m depth). They are characterized by a lower TOC content and iron-rich spectral signatures (d445, d525, and a*).

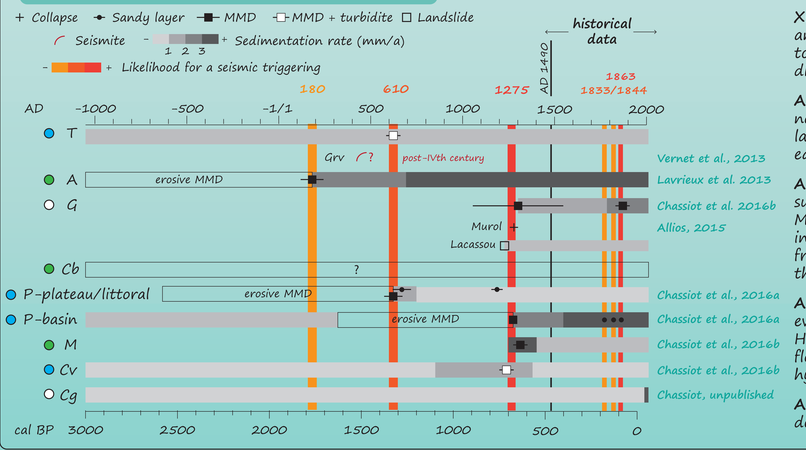
Recent bottom mixing event following lake overturn are suspected to be involved in their formation. Deep (> 60 m depth) ferruginous waters went upward, leading to the oxidation of dissolved Fe2+ into Fe3+, thus coloring surface waters and sediments in yellow-red. This theory is supported by:

- (1) modern analog observed in meromictic lakes from Cameroon (Nyos) and Costa Rica.
- (2) historical observations in AD 1786 and AD 1936 reporting sudden color changes and sulfur smells in Pavin.

Chassiot et al., 2016a
Meybeck, 2016

Cabassi et al., 2014
Rouwet et al., 2014

HOLOCENE PALEOSEISMOLOGY



XIXth century : numerous earthquakes were reported in south Limagne and Mont-Dore areas. Two event deposits in P and G have been related to AD 1863 earthquake (MSK V). A sandy layer in P could be linked to distant AD 1833 event (MSK VII) or nearby AD 1844 event (MSK V).

AD 1490 : the strongest earthquake in Auverge (MSK VIII). No synchronous event has been found in natural archives. This may be explained by large (30 km) lake-epicenter distances. Slope failures related to former earthquakes also contributed to lower lake sensitivity to seismic shakings.

AD 1275 ± 50 : co-eval events (wall collapse, MMDs, and turbidites) support the occurrence of a undocumented paleo-earthquake in the Mont-Dore. High sedimentation rates consecutive to land-use changes in Cv and M enhanced lake sensitivity to seismic shakings. Basal age from Lake Lacassou formed on the Dent-du-Marais landslide also suggests this event is younger than previously reported.

AD 610 ± 50 : crater outburst and associated MMDs in P along with co-eval sandy layer in T may have been triggered by a common earthquake. Historical accounts documented a seismic event in AD 542, but also flooding events around AD 580. Seismite layers in Grv support the first hypothesis despite a 70-yr offset with radiocarbon chronology.

AD 180 ± 60 : delta collapse and MMD in A. The absence of synchronous deposits in other archives does not support a seismic triggering.

CONCLUSIONS

The identification and dating of sedimentary events from FMC natural archives indicates several types of geohazards have occurred during the Late Holocene. First, the refined event chronology highlights co-eval deposits across several lakes related to historical tectonic events. Their record were determined by basin slopes, lake-epicenter distance, MSK intensity, and human-induced fluctuations in sedimentary load.

Second, yellowish and iron-rich deposits identified within Lake Pavin sediments suggest lake overturns occurred in a recent past. Although the gas hazard remains limited at Lake Pavin, these unusual deposits may support further research about limnic hazard in similar settings.

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