Combining multi-variate palaeoecological indicators and mining closed gradual patterns for refining past lake dynamics and the induced ecological legacies

Yannick Miras*†[1], Aude Beauger[2], Jerry Lonlac Konlac[2], Benjamin Legrand[3], Delphine Latour[3], Karen Serieyssol[4], Marlène Lavrieux[5], Jean-Luc Peiry[6], and Engelbert Mephu-Nguifo[7]

[1]Histoire naturelle de lHomme préhistorique (HNHP) – Museum National d'Histoire Naturelle, Université de Perpignan Via Domitia, Centre National de la Recherche Scientifique : UMR7194 – Institut de Paléontologie Humaine 1, rue René Panhard 75013 Paris, France

[2]Laboratoire de Géographie Physique et Environnementale (GEOLAB (UMR 6042/CNRS)) – geolab – 4 rue Ledru 63057 Clermont-Ferrand cedex 1, France

[3]Laboratoire Microorganismes : Génome et Environnement - Clermont Auvergne (LMGE) – Université Clermont Auvergne : UMR6023, Centre National de la Recherche Scientifique : UMR6023 – Campus des Cézeaux / 24, avenue des Landais BP 80026 / 63170 Aubière, France

[4]EVS-ISTHME – UMR EVS – France

[5]Institut des Sciences de la Terre dOrléans - UMR7327 (ISTO) – Bureau de Recherches Géologiques et Minières (BRGM) : UMR7327, Institut national des sciences de lUnivers : UMR7327, Université d'Orléans : UMR7327, Centre National de la Recherche Scientifique : UMR7327, Institut national des sciences de lUnivers : UMR7327 – Campus Géosciences 1A, rue de la Férollerie 45071 Orléans cedex 2, France

[6]Environnement, Santé, Sociétés (ESS) – Centre National de la Recherche Scientifique : UMI3189 – France

[7]Laboratoire dInformatique, de Modélisation et dOptimisation des Systèmes (LIMOS) – SIGMA Clermont, Université Clermont Auvergne : UMR6158, Centre National de la Recherche Scientifique : UMR6158 – Bât ISIMA / Campus des Cézeaux BP 10025 / 63173 Aubière Cedex, France

Abstract

The overloading of water bodies with nutrients is a widespread ecological alteration. A recent synthesis (CNRS, IFREMER, INRA, IRSTEA) shows that lake ecosystems are particularly concerned by the eutrophication process which results in: (1) ecological disturbances (e.g. invasive species, loss of biodiversity, algal and cyanobacterial blooms), and (2) public health problems (e.g. water quality degradation due to cyanotoxin production). This makes the restoration of eutrophic freshwaters an environmental top-priority and a key-issue for scientific research. Accurate assessments of the present-day lake ecosystems state are thus needed. Moreover, long-term retrospective models of lake dynamics must be developed concomitantly to the analysis of natural and anthropogenic modifications of the catchment,

*Speaker

†Corresponding author: yannick.miras@mnhn.fr

which enhance the external input of sediment and nutrients. Palaeoecological researches are therefore required because they characterize through time the lake's responses to cumulative changes caused by natural (e.g. climate) and anthropogenic impacts (e.g. vegetation clearance, agriculture). They furnish thus fresh insights into a good understanding of the ecological legacies which also determine current lake structure and function, and which must be considered for sustainable lake management. A palaeoecological research was conducted in the hyper-eutrophic Lake Aydat (837 m a.s.l.), located in the Chaîne des Puys (French Massif Central). The high resolution and multi-proxy analysis (pollen, non-pollen palynomophs, diatoms, sedimentology) was combined to an approach of data mining (extraction of frequent (closed) gradual patterns of multi-variate indicators under temporal constraint) and allow to address the:
(1) reference conditions of the lake (prior to extensive human impact) and its natural variability;

(2) aquatic changes phases: timing, intensity, frequency, delay;

(3) reversibility or directions in which the lake is driven by the long-term cumulative impact (e.g. loss of resilience, ratchet effect);

(4) potential drivers: climate *vs* the diverse range of land uses;
(5) degree of resistance/sensitivity and vulnerability of present-day lake ecosytems.