Climatic, environmental and pollution traceability of the monumental Olive and Cedar trees of Lebanon: Lessons from the past to the present

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Among the Mediterranean vegetation, olive and cedar trees are significant symbols, with the former considered among the oldest trees in the Mediterranean basin. In Lebanon, those trees survive at diverse altitudes, standing as a testimony to their long history and socio-economic role.

The Mediterranean basin is classified as an area vulnerable to climate change. Its species persisted in this area due to the low amplitude of temperature change between the last glacial period and the Holocene. The Middle East and North Africa region is a major contributor worldwide to global health and climate change emissions over the past three decades.

Understanding how these trees have and will survive the different cultural, climatic and environmental shocks, and how will they continue to persist among upcoming changes, is a scientific challenge.

Trees are considered a good archive for environmental and climatic data. Using stable isotope (C,N,S,O,H) to study tree response to climatic and environmental factors are now widely used. They can act as important tracers of how plants today and in the past, have interacted and responded to their abiotic and biotic environments. The O and C isotopic of bulk wood or purified cellulose from tree rings, has offered good record of the ecophysiology of the plants, resources they use, and environments they inhabit, now and in the past.

Due to the development of MCICPMS technique, Hg, Pb contents and isotopes can be analyzed to help reveal the problem between climate and anthropogenic contamination pollution effect. We can track the source of pollution and measure concentration through the content and isotopes within different tree tissues (leaf, stem, wood). Thus, pollution and climatic records can be
obtained on tree archives over various time scales through metal isotopes (Pb, Hg) and stable isotopes (CNHOS).

This study aims to examine the present and past conditions of monumental olive and cedar trees, through studying and comparing the present and past isotopic and radiogenic variation; and create a dataset to help anticipate and predict climatic discrepancies using interdisciplinary approaches.

Two ancient olive groves were selected, Bchaaleh (1300m-North), Kawkaba (672m-South), and one cedar tree site, Maasser El Chouf (1700m-Mount Lebanon).

Leaves, stems and rainwater samples are collected on monthly basis, and soil sediment and litter collected on quarterly basis from the olive sites. For cedar, seasonal collection is conducted to achieve a multi isotopic study for the present. To create data for the past, 212 wood cores were collected from 32 centennial olive trees and 21 cores were extracted of 8 cedar trees.

We expect to establish a database of stable and radiogenic isotopic signatures of recent and past olive and cedar elements. In addition to having a comprehensive interpretation of stable and radiogenic isotopic variations at seasonal scale through the applied time series, and calibrating between the isotopes of the tree and current climate. The study of trace elements contents, Pb and Hg isotopic ratio, will allow the reconstruction of anthropogenic pollution evolution of trees, tracing the sources of pollution.

Tree rings will provide information on paleoclimate and dating it back from the beginning of the industrial period.