

Forensic Geology: Characterisation of Light Element Stable Isotopes in Soil Samples of the Swiss Plateau

MAROLF André Ronnie ; juillet 2010

Supervisor : Prof. Torsten VENNEMAN et Dr. Jeanne Bonzon, Institut de Minéralogie et Géochimie

The purpose of this Master Thesis is to characterise soil samples from the Swiss Plateau for their stable carbon and oxygen isotope compositions. Five sampling locations were chosen in the cantons of Geneva, Vaud, Fribourg and Valais, and six in the canton of Zurich. The coordinates of the latter locations have been taken from real crime scenes (anonymised). Fourteen samples per location were collected for all localities except for the canton of Zurich where six samples per location were chosen, following a regular pattern for all localities. All the soil samples were characterised for their carbon and oxygen isotopic composition via Isotope Ratio Mass Spectrometry (IRMS). Organic compounds have been removed and carbonates and silicates analysed separately with a GasBench II, respectively a CO₂-laser based extraction line, both linked to an IRMS.

The results indicate that carbon and oxygen isotopes are a promising tool to investigate variations in soils from the Swiss Plateau, but distinguishing between locations in the same region is still challenging. Despite these difficulties, three major domains can be clearly distinguished and the data shows that isotopes can be an additional, new fingerprint of soils. The domains of Valais (Martigny), the Romandie (Lausanne, Genève, Yverdon) and the Zürich region (Gockhausen, Hausen-am-Albis, Kindhausen, Oetwil-an-der-Limmat, Wallisellen and Wiesendangen) can be distinguished. A fourth domain (Fribourg), however, slightly overlaps the Zürich region and the Romandie domain and hence remains ambiguous.

The fact that other results show similar values for carbonate, quartz, and clay minerals analyses could indicate that the Molasse and the corresponding Quaternary deposits are the main sources of inorganic soil material. Even if the formation and evolution of soils are still not well understood in detail, biological activity is unlikely to influence the mineralogy of soils in a major way, although local differences related to organic acids may be present. The data provide new insight into chemical and physical processes of soil formation and may thus be of help for interpretations of the geology, pedology, and for forensics. More analyses of soils will certainly help to provide further and additional constraints on soil provenance in time and space.

Keywords: Forensic geology; Stable isotopes; Soil sample; Swiss Plateau; Isotope Ratio Mass Spectrometry (IRMS); Provenance determination; Carbon isotopes; Oxygen isotopes; Molasse