

Pag 78

Linking earth sciences, terrestrial ecosystems and social sciences in critical zone study: the project ABRESO (Belmont Forum)

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The term Critical Zone (CZ) has become in the last decades a main focus of interdisciplinary studies in the field of natural sciences. Defined as the system of chemical, biological, physical and geological processes operating together to support life at the earth surfaces (Brantley et al., 2007), the CZ supplies nutrients and energy that sustain terrestrial ecosystems.

The impact of humans on the CZ has significantly increased over time, radically changing the chemistry of atmosphere, hydrosphere and pedosphere, and reshaping earth's surface. The challenge of crossing disciplines, space and timing is becoming a peculiar feature in the study of CZ's processes.

Earth scientists are involved in CZ studies investigating weathering, soil formation, erosion, surficial water cycle, element mobility, fluxes and provenance, abiotic and biotic redox reactions, rate and reaction mechanisms at the mineral-organism-water interface. Isotopic systematics significantly contribute to these CZ topics and currently include traditional and non-traditional stable isotopes, radiogenic isotopes, and fission products. The multi-isotopes toolbox is successfully applied also to investigate nutrient cycling at the soilwater- plant boundary.

The ABRESO project (Abandonment and rebound: Societal views on landscape and land use change and their impact on water and soils) is part of the pull of international projects funded by the Belmont Forum to orientate CZ researches on soil and water sustainability in landscapes undergoing transitions. The transdisciplinary approach is the main feature of the ABRESO project, where natural and social researchers share the goal of studying land abandonment in different contexts and countries (United States, Italy, Taiwan, France and Japan). In Italy, three case studies have been selected in the eastern and western part of the Alps. Here, land use changes from grazing and terrace cultivation to abandonment and forest recolonization are observed. In the project, processes occurring at the ground level (involving soil and vegetation) are investigated using chemical and isotopic tools that include carbon and nitrogen concentration and isotope composition in soil and plants, CO₂ fluxes, soil physical properties (e.g., texture, aggregates stability, pH, electrical conductivity). These parameters are applied to characterize the transition between old forest-young forest-pasture. We upscale these observations in space and timing (20 years) using remote sensing. We work on time series of land cover maps extracted from satellite and aerial images and trends in snow cover duration over the past 20 years. In ABRESO, the natural science complements with the social scientists, given that bio-geo chemical processes associated to land use and land use change respond also to social and economic drivers. An effort is done to compare the main ecosystem services deduced by the bio-geochemical investigation with the perception of local stakeholders in charge of land management practices and policies. Ongoing findings of our project underlines that the interaction between natural science scientists, providing conceptual modelling on the soil-water-vegetation system, and social science scientists, addressing stakeholders' perception on the socio-economic impact of land-use change on the local population, is nowadays becoming a priority to promote a sustainable management of the evolving ecosystem.

Brantley S.L., White T.S. & Ragnarsdottir K.V. (eds.) (2007) - The Critical Zone: Where Rock Meets Life. Elements, 3(5).