Preface: *Fluids and tectonics*

The 8th International Conference on Gas Geochemistry provided the opportunity for scientists from different countries to meet each other, exchange ideas on the state of the art in gas geochemistry, and discuss advance in fluid geochemistry. The 8th ICGG meeting focused on three main geologic environments currently interacting with the human life: volcanoes, earthquakes and hydrocarbons.

Ninety-four presentations gave participants chance to cover a variety of important research topics on gas geochemistry in geosciences including: gas migration in terrestrial and marine environments, Earth degassing and its relation to seismicity, volcanic eruptions, rare gases and application of isotope techniques, measurement and analytical techniques. This special issue of Annals of Geophysics *collects some of the papers presented dealing with the general problem of the relation between fluids and tectonic activity. Since virtually all geodynamic processes are related to fluids, the conference constituted a further step to enhance our understanding of the special role of gases in the sesismogenic processes.*

The scientific sessions held in the ancient castle of the town of Milazzo were dedicated to a debate on this problem and were introduced by an invited lecture by G. Valensise from INGV, Rome entitled «Beyond earthquake prediction: gas geochemistry for investigating the structure and evolution of seismogenic areas». He emphasized how fluid geochemistry is a fundamental tool for filling in basic information gaps on where potential earthquake sources are, especially in areas of blind faulting or where the surface evidence for fault activity is limited. The prime target is to establish closer links between the active tectonics and fluid geochemistry communities, aimed at understanding how the Earth works from a broader multidisciplinary perspective.

The concepts expressed by G. Valensise found many links in the talks given by K. Notsu, the director of the Earthquake Chemistry Laboratory, Tokyo University, on the release of mantle helium related to fault activity and deep tremor, and by D. Hilton from San Diego, U.S.A. on the helium isotope in seismically-active regions of the San Andreas Fault Zone and the North Anatolian Fault Zone who provided the latest results obtained coupling isotope geochemistry and seismotectonics. Other significant examples were given in the presentations by H. Woith, from the GFZ in

Potsdam, on the detection of earthquake-induced pore pressure variations by fluids monitoring, together with that of H. Kämpf from the GFZ in Potsdam on the combined gas-geochemical and geophysical studies on the earthquake swarm area of Vogtland-NW-Bohemia who provided the most advanced insights into the combined seismological and geochemical approach to studying the seismogenic process. New perspectives on understanding CO_2 generation by mechanical stress application on carbonate rocks were presented by F. Italiano, G. Martinelli and P. Plescia.

The evidence that nowadays all efforts provide useful and new results should push the scientific community to pursue this direction. In the past, the study of seismic events was carried out considering every aspect, as is verifiable on a broader basis in the study of every natural phenomenon, leading to a better grasp of seismic phenomena and the achievement of important results obtained in a few test areas where research projects have been carried out in considerable depth and breadth (Heinicke and Martinelli, 2005).

The activity of geochemical monitoring of the seismic areas carried out lasting recent years is based on modelling fluids circulation and interaction, defining their behaviour in a seismic-prone area. The geodynamic context of an area may strongly influence the fluids composition and behaviour in terms of both chemical and isotopic composition as shallow-originated fluids may mix with fluids coming from different depths of the crust and upper mantle. The mixing proportions may change over time due to both seasonal variations and crustal permeability modifications because of the development of a seismogenic process (stress accumulation, deformation, strain release, etc.). Monitoring fluids circulating over a seismic-prone area will address the consequences induced by the development of the seismogenic process that may or may not generate a «seismic shock». Following such an approach, geochemical monitoring is not related to the occurrence of an earthquake, but investigates all the modifications related to fault movements through the chemical and isotopic changes shown by the fluid phases rather than «chasing» seismic events. The main targets to achieve are a genetic characterization of the fluids on the basis of their chemical and isotopic features and an evaluation of temporal variations in terms of both chemical and isotopic composition. Sampling carried out at regular time intervals over a long time-span allows the assessment of seasonal variations thereby distinguishing the changes induced by development of the seismogenic process. This will disclose «anomalies» in fluid behaviour related to modifications at depth induced by tectonic movements. If prolonged over time, such a methodological approach applied to every single investigated area will determine what and how it changes before, during and after a seismic crisis.

However, in spite of a general consensus among geochemists regarding the methodological approach and the field and laboratory activities, few authors has provided well assessed connections between fluids and changes in local tectonic activity.

The main reason is probably the relatively poor knowledge of the earthquake source physics. Much attention has focused on «detecting» earthquakes, hence determining where the hypocenter and the epicentre are located (multiplication of denser and denser seismic networks). In the meantime, less scientific effort have been devoted to what happens in porous media and circulating fluids before, during and after seismic shocks have developed. For these reasons, many questions (e.g., *how friction between rocks is overcome when slip occurs on a fault? or what happens to hanging walls when fast rate slip generates an earthquake?) remain open, making it clear that a complete understanding of the seismogenic process as a whole is far from complete and only multidisciplinary approaches will provide useful results in the future.*

The contribution of this special issue to enhancing our knowledge of the seismogenic process moves from an attempt to express the links connecting the geochemical features of fluids to tectonics with some examples from seismic areas of the Czech Republic, Italy, Germany and Kamchatka.

We all know that seismic events are far from being prevented, but we have to improve our basic knowledge on the seismo-tectonic processes occurring beyond the earthquake preparation process that influence the fluid regime. Gases and waters are typical fingerprints of crustal deformation processes, and we must remember that monitoring Radon emission was the first approach to geochemical monitoring activity. Increases in radon concentration were observed in water from a deep well prior to the huge Tashkent earthquake (7.5 on the Richter scale) of April 26 1966 (Ulomov and Mavashev, 1971). Since then, both, soil gas and ground-water Radon concentration changes have been observed and considered potential precursors for earthquakes. Radon concentrations in the vicinity of faults have been unusually high and many researchers have monitored the radon content in deep wells as a potential predictor of earthquake activity. As a general result, they found a gradual increase in concentrations until the time of an earthquake, then radon emission decreases rapidly, although some variations can be observed related to earthquake aftershocks. Similar behaviour is observed for all circulating fluids. Those results yielded very important information for geochemists: hydrogeological and geochemical phenomena related to the earthquake preparation process are matters of controversy for many reasons including: changes in earthquake source characteristics; re-

sponse heterogeneity in time and space, and, although fluids are good strain indicators, the physical relation to strain is still not well understood.

In the recent past the approach was aimed directly at earthquake forecasting and did not provide useful results in that direction. Nowadays major efforts are dedicated to detecting all the fluids released and investigating the possible relations with other chemical and physical phenomena with the aim not to forecast any earthquake but to improve our knowledge of what occurs beyond the earthquake.

The paper entitled «Investigating correlations of local seismicty with anomalous geoelectrical, hydrogeological and geochemical signals jointly recorded in Basilicata Region (Southern Italy)» by G. Colangelo et al.*, describes variations detected coinciding with the local seismicity. Four papers in the volume are devoted to various aspects of radon gas, from a detailed revision of the detection techniques «Measuring radon in soil gas and groundwaters» by Constantin Papastefanou, to evidence of Rn degassing over three different geologic environments in Italy, Kamchatka and Poland: the papers entitled «Indoor and soil radon measurements in the Hyblean Foreland (South-East Sicily)» by C. Antoci* et al.*; «The nexus of soil radon and hydrogen dynamics and seismicity of the northern flank of the Kuril - Kamchatka subduction zone» by P.P. Firstov* et al. *and «Radon and its daughter activities in magmatic areas of the Karkonosze Granite and adjacent volcano-sedimentary Intrasudetic Basin» by A. Solecki* et al.

Three papers present results collected by mid to long-term geochemical monitoring in Germany: U. Koch and J. Heinicke «Hydrological influences on long-term gas flow trends at locations in the Vogtland/NW Bohemian seismic region (German-Czech border)» and in Italy «The Porretta thermal springs (Northern Apennines): seismogenic structures and long-term geochemical monitoring» by N. Ciancabilla et al. *and «Anomalous pattern of geochemical data recorded in the seismically active site of Pieschi (Southern Italy)» by G. Colangelo* et al. *Earth degassing is discussed with the methane-dominated gas emissions in Romania by C. Baciu* et al. *in «Mud volcanoes and methane natural emissions in Romania».*

The 8th ICGG meeting of Milazzo clearly demonstrated that a large and highly scientific community of «Earthquake Chemists» is actively working with seismologists and geophysicists. Traditional cultural barriers have been broken and a new, in some ways pioneering, spirit was felt by participants.

Challenging tasks for the next ICGG9 conference to be held in Taipei in October 2007 (Tsanyao Frank Yang organizer) will focus on a better definition of fluid-porous media interaction processes, a better statistical evaluation of experimental data, a better definition of earthquake source physics and its associated chemistry.

Further attention will be devoted to the assessment of volcanic precursors and the description of geothermal reservoirs and hydrocarbon systems. Pioneering novel researches designed to evaluate the Earth's evolution will flank advance in cosmochemistry and contribute to a wider dissemination of the innovative scientific and technologic features character of this kind of meeting.

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