

Scientific report

on the implementation of the project between January – December 2012

GEOGENIC EMISSIONS OF GREENHOUSE GASES FROM GEOTHERMAL AND PETROLEUM SYSTEMS- APPLICATION TO ROMANIA

PN-II-ID-PCE-2011-3-0537

The main activities performed between January-December 2012 have been mainly focused on work packages no. 1 and 2.

WP1 – State-of-the-art at national/international level

This work package started in the first year of the project, and continued for the first 3 months of the current year. In this stage, we continued our activities regarding the synthesis of information regarding the natural emissions of GHG at a national and international level. More than 300 publications were analysed in total. The data regarding Romania were synthesized in a database which contains more than 100 entries, and will be updated during the project with new data. As an example of the outline of the database see figure 1.

site	subsite	basin/region	type	lat	long	Area meas. (m2)	CH4 flux					
							mean (mg m ⁻² d ⁻¹)	min	max	st.dev	output (t/y)	
Andreiasu	EF 2008	Eastern Carpathians	Gas	45.75119	26.83246	400	168141	87000	245000	111723	50	
	EF 2012			45.75072	26.83303	300	5555528	1374	124486437	88024232	58.3	
Lopatari		Eastern Carpathians	Gas	45.53586	26.54872	48	23241660	766	297748823	210539670	15.4	
Bacau Gheraiesti	Spring 2007	Eastern Carpathians	Gas	46.65054	26.94176	250000	27000	2183	<100	20900	14708	9
	Autumn 2007						20	<2	5852	4137	-30	
Lepsa		Eastern Carpathians	Gas	46.00386	26.49233						1.5	
Raiuti		Eastern Carpathians	Gas	45.82600	26.83711	12	32019031	0	174702059	123533011	8.4	
Sarmasel	Sarmasel 1 Mai 2007	Transylvania	Gas	46.75000	24.15000		3610	15000	70	2500000	1767717	251
	Sarmasel 2 Mai 2008						25453	2560	384	12386000	8757953	595
Deleni	Deleni 1 2008	Transylvania	Gas	46.27639	24.33806		2285	800	208	4672000	3303456	16.8
	Deleni 1 2009						650	2583	236	367761	259879	1.9
	Deleni 2 2008						1650	1256	352	1664000	1176377	2.72
	Deleni 2 2009						4			990143	7100416	4320615
Praid		Transylvania	Gas	46.53997	25.11463	30	448442	85492	592872	358772	4.38	

Molecular composition													
CH4 %	C2	C3	C4		C5		C6+	CO2	N2	Ar	He	H2	H2S
			normal	izomer	normal	izomer							
93.73	1.89	0.5400	0.1100	0.1100	0.0200	0.0410	0.0220	1.93	1.58	0.025			
95.05	1.94	0.5707	0.1437	0.1216	0.0369	0.0601	0.0710	1.97	0.04	0.001	0.0000	0.000	
96.16	1.82	0.7542	0.2836	0.1655	0.0888	0.1111	0.1094	0.26	0.16	0.001	0.0027	0.000	
93.81	2.98	1.1300	0.2600	0.3100	0.1300	0.0890	0.1300	0.08	1.06	0.014	0.0033		
89.35	0.77	0.0791	0.0181	0.0006	0.0000	0.0081	0.0027	7.96	1.80	0.010	0.0016	0.000	
95.55	1.23	0.3680	0.1043	0.0680	0.0346	0.0433	0.0842	1.07	1.41	0.010	0.0126	0.0032	
99.25	0.087	0.0079		0.0018				0.11	0.53	0.011	0.0021		
98.6517	0.086	0.079	0.000	0.003	0.000	0.0000	0.000	0.422	0.687	0.006	0.056	0	0
98.016	0.017	0.015	0.000	0.029	0.000	0.000	0.000	0.442	1.467	0.009	0.004	0	0
91.09	0.31	0.0740	0.0120	0.0150				7.37		0.68	0.45		

Fig. 1. Fragment of the gas emission database in Romania.

This database was uploaded on an internet data-sharing application, in order to enable each involved researcher to update and upload new data in it.

WP2 – Field investigations

The second work package is dedicated to field surveys and laboratory analyses, and was planned for a total of 18 months, starting from the 5th of April. In 2012 the following regions were investigated: the central and southern part of the Eastern Carpathians, the Transylvanian Basin and the Banat region.

Multiple field campaigns were undertaken in the Eastern Carpathians, in order to evaluate the carbon dioxide flux. The main locations were: Corund, Balványos, Sugas, Turia, Ciomadu, Homorod, Craciunel, Madicsa, Sanraieni, Vrabia, Lazaresti, Bancu, Frumoasa, Rodna, Anies, Lunca Ilvei. Also gas samples were collected for molecular and isotopic analysis. The samples were sent to the Nuclear Research Institute ATOMKI from Debrecen.

As carbon dioxide appears as free and dissolved gas in water, a special attention was given to the mineral water springs. The gas fluxes were measured at the springs, and water and gas samples were collected for molecular and isotopic analyses. Another field campaign was performed in the western part of the Eastern Carpathians, for sampling the sparkling mineral waters. Thanks to collaboration with INGV Palermo, the samples were analysed by: ion-chromatography, gas-chromatography, helium content, carbon-13, and oxygen 18, deuterium measuring methods. Currently, the PhD student Kis Boglarka is undertaking a 4 month-long internship at INGV Palermo, in which she is analysing and interpreting the data obtained by analysing the above mentioned samples.

In summer 2012 another field campaign was performed for investigating the everlasting fires from the flysch sector of the Eastern Carpathians, and the Carpathian Foredeep. We investigated the following locations: Andreiasu, Raiuti, Lopatari, and Lepsa. These manifestations are quite frequent in the Eastern Carpathians, but quite rare at a European level. These everlasting fires can be found only in some European countries. The methane and carbon dioxide fluxes were measured on sites; gas samples were collected, which were analysed at Isotech Illinois. The data are currently being prepared for an international publication. The Banat area was also investigated for carbon dioxide emission in the location of Fibis, and gas samples were collected for isotopic analyses.

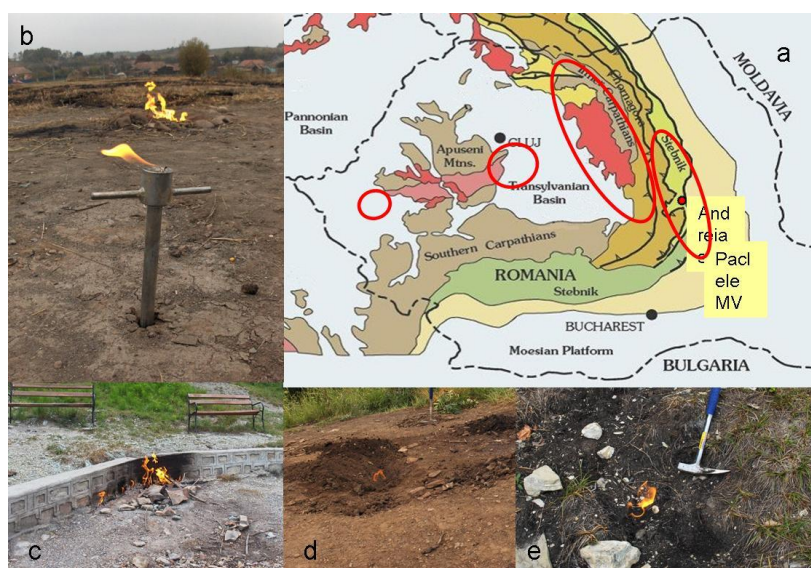


Fig. 2. a. Field investigation areas (January-December 2012); Everlasting fires from Transylvania and Eastern Carpathians: b. Sarmasel; c. Andreiasu; d. Lopatari; e. Raiuti.

Dissemination activities

These activities consisted of participations in conferences and publications in scientific journals. A part of the present year's field results were published, while others are in progress. The research team had participated in 3 international conferences, and published 5 articles, 2 of which are in ISI journals, with IF above 1.5, 3 publications indexed in international databases, two of which published in the prestigious Elsevier Press.

Conference participations:

1. **"International Multidisciplinary Scientific GeoConference" – SGEM 2012**, 17-23 June, Albena, Bulgaria; oral presentation: **C. Baci**, **N. Frunzeti**, **A. Ionescu**, **D. Costin**, **C. Malos** – ***Geogenic gas emissions in Romania and their value for tourism.***
2. **"Environmental Legislations, Safety Engineering and Disaster Management" – ELSEDIM 9th edition**, 25-27 October 2012 Cluj-Napoca, oral presentation: **B.M. Kis**, **N. Frunzeti**, **C. Baci**, **I.C. Pop** – ***Post-volcanic phenomena related to the Neogene-Quaternary volcanism of Harghita Mountains: case study – Baile Homord (Harghita county, Romania).***
3. **"First European Radon Symposium" – FERAS 2012**, 2-5 September 2012 Cluj-Napoca, with: **N. Frunzeti**, **M. Moldovan**, **A. Ionescu**, **B. Burghel**, **C. Baci**, **C. Cosma**, **G. Popita**, **L.C. Stoian** – ***Flux measurements of ²²²Rn, CO₂ and CH₄ along with soil gas concentrations (²²²Rn, CO, NO₂ and SO₂) over a methane reservoir in Transylvania (Romania).***

Publications:

1. N. Frunzeti, C. Baci, G. Etiope, H. Pfanz H., 2012, Geogenic emissions of methane and carbon dioxide at Beciu mud volcano, (Berca-Arbanasi hydrocarbon bearing structure, eastern Carpathians, Romania), Carpathian Journal of Earth and Environment Sciences, Vol. 7, No. 3, p. 159-166. IF = 1.579
2. N. Frunzeti, C. Baci, 2012, Diffuse CO₂ emissions at Sfanta Ana lake-filled crater (Eastern Carpathians, Romania). Procedia Environmental Sciences 14, 188-194, Elsevier.
3. B.M. Kis, B. Czellecz, C. Baci, L. Kekedy-Nagy, 2012, Hydrogeochemical features of some mineral waters at the contact between Harghita Mts. (Eastern Carpathians) and the Transylvanian Basin. Procedia Environmental Sciences 14, 195-206, Elsevier.
4. C. Baci, N. Frunzeti, A. Ionescu, G. Etiope, D. Costin, C. Malos, Geogenic gas emissions in Romania and their values for tourism. Proceedings International Multidisciplinary Scientific GeoConference SGEM 2012, 439-46.
5. C.C. Allen, D.Z. Oehler, G. Etiope, P. Van Rensberger, C. Baci, A. Feyzullayev, G. Martinelli, K. Tanaka, D. Van Rooji, 2013 Fluid expulsion in terrestrial sedimentary basins: A process providing potential analogues for giant polygons and mounds in the Martian lowlands. Icarus (in press), IF = 3.385, RIS = 2.14118

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- Baci, C; Etiope, G. 2005, *Mud Volcanoes, Geodynamics and Seismicity*, 51, 77-87, Springer Verl.
- Etiope, G., Baci, C., Caracausi, A., Italiano, F. & Cosma, C., 2004, *Gas flux to the atmosphere from mud volcanoes in eastern Romania*, Terra Nova, 16, 179-184.

Project leader

Professor Laurentiu-Calin Baci