Editorial to the fourth issue of "International Journal of Terrestrial Heat Flow and Applied Geothermics"

Jorge L.S. Gomes [1] and Valiya M. Hamza [2]

[1] Inst. of Science Engineering and Technology, Federal Uni. of the Jequitinhonha and Mucuri Valleys, Teófilo Otoni, Brazil.
[2] Dep. of Geophysics, Obs. Nac. Rio de Janeiro, Brazil.

The fourth issue of the *International Journal of Terrestrial Heat Flow and Applied Geothermics – IJTHFA* stands out as a step further in bringing together several important works on geothermal research. It is indication that this journal is a closer to being recognized as a convenient and useful forum for dissemination of research results and information within the IHFC community. The organizers of the International Journal of Terrestrial Heat Flow and Applied Geothermics (IJTHFA) received thirteen manuscripts, which after due review process were accepted for publication. Given below is a brief overview of the accepted contributions.

The papers appearing in this fourth issue have been divided into five groups. The first one deals with topics related to data analysis and resource assessment while the second one is devoted to works on regional studies. The focus of the third group is on theoretical model studies on formulations of problems associated with combined modes of heat transfer in the upper crust. The fourth section is composed of four works where the main themes are estimation of ground surface temperature (GST) variations arising from climate changes of the recent past coupled with changes in vegetation cover. The last group is devoted to memories of late Alan Beck who served as chairman of IHFC during 1983 to 1987.

The first paper is a contribution on global heat flow data analysis. It is authored collectively by 19 members of the international heat flow community and has focus on organization of global heat flow data sets. The second contribution addresses pros and cons of sustainability in exploitation of geothermal resources and problems in heat mining. The next contribution concerns analysis of heat flow data for mainland Africa. It points out the importance of taking into consideration of general heat flow variations in addition to those in regions of magmatic activity.

The second group has three contributions dealing with results of regional geothermal investigations. Considers our understanding of heat flow variations in such areas of vital importance in geothermal studies as the east European platform including the Orsha depression in Belorussia. Diego Borba and collaborators discuss bottom-hole temperatures in the upper Amazon basin of Ecuador. Another notable contribution is that of Andrew Tyoh and collaborators of geothermal gradient and heat flow in the Bornu-Chad basin of Nigeria.

The third section deals with model studies on heat transfer problems. The first of these contributions, by Prof. Carlos Alexandrino and his collaborators provides new insights into theoretical models of two-dimensional thermal fields associated with groundwater flows in porous media. Following this paper Prof. Vitor Colombo and collaborators discuss numerical models describing thermal energy exchange in underground mine ventilation systems.

The fourth section deals with investigation of changes in surface and subsurface temperatures arising from climate changes of the recent past. Notable advances have been reported in the role played by changes in vegetation cover on ground surface temperatures. The regions investigated include Western Canada sedimentary basins, the region of Gottingen in eastern Germany, Rocky Mountains of western Canada and Amazon region in northern Brazil.

The last section is devoted to memories of late Prof. Alan Beck of the Western University who served as past president of IHFC during the period of 1983 to 1987. We thank Lalu Mansinha of Western University for academic collaboration.

Concluding Remarks

The editors of this journal are indebted to members of the International Geothermal Community who contributed to successful publication of this issue.

Special thanks are due to those who took part in reviewing the manuscripts. The list of distinguished reviewers for this issue includes Antonio Correa (University of Evora, Portugal), Jacek Majorowicz (now retired) of the Geological Survey of Canada, Jan Safanda (Institute of Geophysics, Academy of Sciences, Czech Republic), Ladislaus Rybach (Earth Science Institute, Switzerland), Maria Rosa Duque (University of Evora, Portugal), Massimo Verdoya (Department of Earth, Environment and Life Sciences, University of Genova, Italy), Sven Fuchs (Thermal Petrophysics Lab, Geo Forschung Zentrum, Potsdam, Germany), Shaopeng Huang (Xi'an Jiaotong University, China and University of Michigan, USA) and Vladimir Cermak (Institute of Geophysics, Academy of Sciences, Czech Republic). We also thank the editorial staff of IJTHFA in contributing with suggestions for improving the grammatical structure and style of writing in the original versions of most manuscripts. These have been most useful for producing this volume.

The Global Heat Flow Data Compilation: History and New Perspectives

Alan Jessop [1] and Massimo Verdoya [2]
[1] Geological Survey of Canada, retired.
[2] DISTAV, Univ. of Genoa, Italy.

At the meeting of the International Heal Flow Commission (IHFC), in Moscow in 1971, two needs were identified. One was to persuade researchers to use the MKS system of units instead of the cgs system. The other was to set up a system for a continuing collection of published heat-flow data. As I was the newly elected Secretary of the Commission, I undertook these tasks.

The first task was easy. A letter, explaining the need and the relation between the two systems, was enough to persuade most scientists to make the change promptly. In those days such letters were sent out on paper, in an

envelope, with a postage stamp on it. The second task was more time-consuming.

There had already been two collections of heat-flow data, the first by Lee and Uyeda in a monograph compiled and edited by Lee in 1965. These collections included all data, continental and oceanic, published up to the end of 1964, and numbered about 2000 items. This compilation was available only in the printed form in a monograph on geothermal topics. The second compilation was published by Simmons and Horai in a journal in 1968, using the format established by the first compilation.

The compilation of 1975 was designed to be accessible on computer as well as on printed pages. For this reason, each line was limited to a maximum of eighty characters, which was the capacity of a computer card. There were no hard drives or global network in those days. I persuaded John Sclater and Mike Hobart, of MIT, to help me. I assembled the continental data, and they assembled the oceanic data. By this time there were 1699 data on the continents and 3718 in the oceans, for a total of 5417.

Temperature and conductivity measurements have different characters. Two temperature measurements provide an average of the temperature gradient between them. Every conductivity measurement gives information about that piece of rock and no other. Thus, it is usually necessary to have more conductivity measurements than temperature readings. Most authors gave numbers of measurements made and an average figure, but no more than that. Some authors showed plots of these data, but that could not be recorded in the compilation. A few authors included observations of heat generation in the rock.

From the beginning it was clear that some heat flow values were more reliable than others. As compilers, we adopted the philosophy that our task was to record and not to judge. We should include as many indicators as possible to guide the user to the quality of the data we were recording. Given the limitations of the recording medium, this was difficult. In addition, some authors did not give adequate information about their measurements, even location. We decided that we could include only the number of temperature and conductivity measurements made and an average value.

Since then, a number of data has been periodically added to Global Heat Flow Database reaching a total of about 60,000 data (36,000 terrestrial and 23,000 marine). However, the Database has maintained its original structure until today. During the IHFC meeting in Montreal (July 2019), a debate was started aimed at fostering improvements of the Database structure, also in the light of the information technology tools at present available. After intensive open discussions with the geothermal community, the IHFC acknowledged the broad range of the community's perspectives on the current Database and the problems associated with it. The growing number of heat-flow values, advances and improvements in scientific methods, digitization and changes in data recording, spreading of invalidated and old versions across the internet have been identified as key arguments for a rearrangement of the Database.

The fourth issue of the "International Journal of Terrestrial Heat Flow and Applied Geothermics" is, on this regard, a milestone. The paper by Fuchs et al. published in this issue presents the results about the new Database structure as a first result of a collaboration program developed by several working groups of researchers from all over the world. This can be regarded as a first step towards the necessary reassessment, quality control and revision of the existing global heat-flow data to meet the modern needs of the whole geoscientific community.