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Foreword

Invited contributions by the 2014 geoscience laureates of the French Academy of Sciences

Every year, the Academy of Sciences gives out a number of prizes and medals to recognize the contributions and achievements of outstanding colleagues in all fields of Science. In 2013, for the first time, the laureates in the domains of Earth and Universe sciences were invited to make short presentations at the Academy. This resulted in a special session that generated enthusiasm from participants. The editorial team of *Comptes rendus Geoscience* felt that it could be of interest to the scientific community to have access to presentations by the laureates from the geoscience area. This resulted in a special issue of the *Comptes rendus* [C. R. Geoscience, 346 (2014), 273–325]. We are happy to renew this experiment for the second time with six of the 2014 laureates who responded to our invitation. Because these were invited papers, an Associate Editor and the Chief Editor played the role normally attributed to reviewers, in addition to their normal editorial duties. In some cases, external reviewers were also involved upon invitation by the editors. We are thankful to the authors and happy to present readers of *Comptes rendus Geoscience* with this second volume of invited contributions by geoscience laureates of the Academy of Sciences.

In the first paper, James Lequeux (laureate of the 2014 Grammaticakis–Neuman Prize) reviews the evolution of material conditions for scientific research in the fields of physics, chemistry, and astronomy in the two and a half centuries between 1600 and 1850. The evolution of support for "salaries" and "equipment", to use modern terms, is estimated by converting ancient currencies into euros, an index to be used with caution, as stressed by the author. Lequeux (2015) shows science evolving from the domain of rich private individuals to more public and collective activities. In the revolution, science becomes more democratic and public. The 18th century witnesses the development of coordinated research and large projects, launched and financed by the Academy of Sciences. Lequeux (2015) finally notes that scientific exchanges between countries fortunately ignored wars.

In the second paper, Jacques Zlotnicki (laureate of the 2014 Cartography Prize) reviews the application of still evolving electrical methods to image the interior and monitor the activity of volcanoes and associated hydrothermal systems. Mapping of electrical potential anomalies provides images of the flow of ground fluids within the complex, faulted structure of the volcano. Surveys, networks and observatories can be setup as a function of volcanic activity. Zlotnicki (2015) demonstrates that strong electric signals may definitely appear hours to weeks before deformation can actually be measured in the field. Transient signals are also recorded from satellites. Both ground and satellite electrical observations may announce the onset of an irreversible process leading to an eruption and have become one of the most efficient tools for volcano monitoring.

Jean-Noël Rouzaud (2014 laureate of the Bernard-and-Odile-Tissot Prize) reviews the structural organization of disordered carbon atoms at the nanometer scale, in order to understand its formation, in diverse conditions (in Nature, in the laboratory or in the course of an industrial process). With his colleagues, Rouzaud has devised a method in which high-resolution transmission electron microscopy (imaging the nanostructure) and Raman microspectrometry (providing quantitative, averaged structural data) are combined. The fields of application are mainly energy and the environment. Rouzaud et al. (2015) illustrate the method in the case of the decontamination of irradiated nuclear graphite waste and detection of hydrocarbons trapped in oil and gas shales, ending with an application to fire traces in prehistoric graves.

In the fourth paper, Cathy Clerbaux (laureate of the 2014 Gérard-Mégie Prize) and ten colleagues from the IASI team review the very successful Infrared Atmospheric Sounding Interferometer space mission, in which spectroscopic instruments measuring in the thermal infrared spectrum on board satellites have provided observations of air composition on a global scale twice a day over the past eight years. In this way, trace gases, pollution levels and

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particle types in the atmosphere have been monitored. After a historical, then a technical overview of the instrumental characteristics, Clerbaux et al. (2015) illustrate the results for three reactive gases, carbon monoxide, tropospheric ozone, and ammonia. Remote sensing observation from satellites now allows one to measure pollution, monitor atmospheric changes and control the implementation of environmental policies. IASI has global coverage capability, day and night observation, and can monitor remote regions. Clerbaux et al. (2015) conclude that the mission allowed operational applications, such as volcanic alerts and pollution forecast and note that the IASI program will continue its long-term observations after 2021, with improved signal-to-noise ratio and spectral resolution.

In the fifth paper, Thérèse Encrenaz (laureate of the 2014 Deslandres Prize) shows how high-resolution spectroscopy in the infrared can image components of planetary atmospheres and monitor changes in the behaviour of minor species as a function of time or location on the planet. Encrenaz et al. have applied the method at the Infrared Telescope Facility in Hawaii, using the Texas Echelon Cross-Echelle Spectrograph, and have been able to monitor hydrogen peroxide, water vapour, and sulphur dioxide on Mars and to show that its atmospheric evolution is well reproduced by Global Climatic Models. On the opposite, the variations of SO_2 above Venus clouds are not reproduced by the models. Encrenaz (2015) finally discusses an ongoing program to monitor the 3D dynamics of Jupiter through maps of the O/H ratio in the deep interior of the planet, but also of ammonia and phosphine.

The issue concludes with Claire Moutou (Laureate of the 2014 Ernest Déchelle Prize) and Magali Deleuil, who review the enormous progress that has been made since the late 1990s in detecting and characterising exoplanets. Astronomers are now able to measure independently the mass and the radius of candidate planets, and therefore to determine their mean densities, giving a first glimpse to their internal structure and beginning to bridge the gap between astronomers and astrophysicists on the one hand, planetologists and geophysicists on the other one. Moutou and Delteuil (2015) describe the major contributions of the CoRoT space-based mission, with which they are closely associated, with in particular the identification of the first "terrestrial" exoplanet. They also review the additional results provided by the NASA Kepler mission and outline the missions that will follow in the coming decade, in the hope of being able to determine the planets' masses to a few percent (in the domain of Earth masses) and to explore their atmospheric properties.

Let me end by congratulating and thanking the laureates who contributed to this issue, and by recalling that *Comptes rendus Geoscience* welcome not only highly innovative papers but also sound and timely reviews of subjects that appear ripe for the exercise, and also proposals for thematic issues on topics that may be of interest to a wide readership.

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