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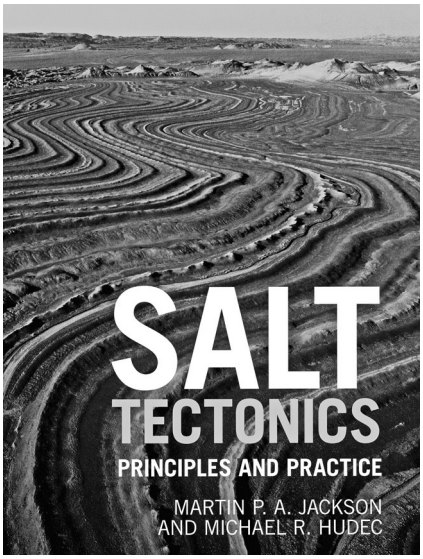
Book reviews

Salt tectonics. Principles and practice, by Martin P.A. Jackson and Michael R. Hudec, 2017. Cambridge University Press, Cambridge. 498 pages. Hardback: price £64.99. ISBN 978-1-107-01331-5.



I have been giving lectures on the interpretation of seismic data at various universities over many years. These touch upon various aspects of tectonics and always contain a very important segment that is devoted to salt tectonics. My motto for this part in my lectures is that salt tectonics is of a very special type – here, it is not regional parameters such as the orientation of a regional stress field etc. that are decisive (as is the case for extensional, contractional or strike-slip tectonics), but the presence of a very specific type of rock, i.e., rock salt or, more generally speaking, of evaporites is. The presence of evaporites within the infill of a sedimentary basin and their specific mechanical properties result in the formation of structures that come into being under regional extension or compression with geometries that are very different from structures formed in non-evaporitic rock series such as clastics or carbonates. Linked to their very complex geometries and higher seismic velocities, seismic imaging of salt structures is very difficult and often yields non-unique results. However, evaporites form excellent seals for hydrocarbons and are often associated with large oil fields, e.g., in the Gulf of Mexico, offshore Brazil, offshore West Africa and in many other basins. However, because of very difficult seismic imaging, exploration for such oil field is highly challenging and requires multi-million dollar investments for seismic surveys and deep offshore wells. All this has resulted in intense studies that are devoted to various aspects of salt tectonics and are conducted by various research groups. One of the key research centres, on a global scale, that deals with salt tectonics is the Applied Geodynamics Laboratory (AGL) at Austin, Texas, USA, within the Bureau of Economic Geology (i.e., the Geological Survey of Texas) and associated with the Jackson School of Geosciences, University of Texas, at Austin. Until very recently, AGL was led by two prominent researchers that pioneered in studies of various aspects of salt tectonics: Professor Martin P.A. Jackson and Professor Mike Hudec. Unfortunately, Professor Jackson died in 2017; today AGL is led by Professor Hudec. Professor Jackson's last publication, his Opus Magnum, is a wonderful book entitled 'Salt tectonics. Principles and practice' and issued by the prestigious publishing house of Cambridge University Press.This book is co-authored by Professor Hudec, long-time collaborator of Professor Jackson.

This tome is, by all means, a unique book. It lacks equivalents in other 'classic' subtypes of tectonics – neither extensional, nor compressional tectonics have comparable treatises, although, without any doubt, these belong to mainstream tectonics.

As suggested by its title, this book deals with two principal areas of salt tectonics, i.e., with theoretical foundations and with various applied aspects.

The book is subdivided into four parts. The first, entitled 'Evaporite deposition and flow', is devoted to two fundamental issues: deposition of evaporites (including, of course, salt) and mechanisms of deformation of evaporites. The latter is of particular importance for a proper understanding of the mechanisms of formation of salt structures and covers various aspects of ductile deformation. It is worth mentioning here that in the brief introduction to this part of the book, the Wieliczka Salt Mine is mentioned as an example and illustration of the significant role that salt has played in human

history. This short paragraph is accompanied by a beautiful photograph of one of the salt chapels of the Wieliczka Mine.

The second part is entitled 'Salt structures'. It contains a very detailed compilation and description of all types of salt structures (salt pillows and salt-related anticlines, salt diapirs, salt sheets, salt extrusions etc.). Also associated structures, such as salt-related mini basins, are described in this part of the book, as are intra-salt deformations, well known to researchers from Poland from the Kłodawa and Wieliczka salt mines. Such deformations, until recently known usually from outcrops in salt mines or from well cores, can be presently imaged by seismic reflection data. This is one of the key reasons why this is one of the fastest developing areas in studies of salt tectonics. This second part of the book contains also a detailed description of salt wealds and their role in salt systems.

The third part of the tome, entitled 'Salt-Tectonic Systems', deals with all geodynamic settings that might be associated with salt structures, such as Extensional salt-tectonic systems, Compressional salt-tectonic systems and Strike-slip salt-tectonic systems. This part also contains very solid descriptions of all key mechanisms that operate in these basic geodynamic settings and therefore should be of great interest for undergraduate, graduate and PhD students. It has an excellent construction: first, various types of salt deformations associated with particular settings are described and then these are illustrated by precisely chosen case studies. In many cases those case studies are derived from the vast archives of AGL.

The first three parts of the book focus on 'Principles', the fourth one deals with 'Practice'. This is of an excellent composition and describes various aspects of the interpretation of seismics, including the role of increased seismic velocity in evaporitic rocks and its role for seismic imaging. Additionally, more advanced problems such as Pre-stack depth migration or interpretation of 2D *vs* 3D data are analysed, including key issues of seismic data interpretation such as the identification of top salt and base salt or identification of salt wealds. The last chapter of this part of the tome is devoted to the role of salt in petroleum systems and contains also a general description of the petroleum system, which should be of great help to less advanced readers. The final parts of the book contain a glossary and definitions related to salt tectonics, an extensive list of references and an index.

The editorial work is superb, the layout of text and all figures top class of clear design and proper execution. The text is interspersed with numerous photographs, diagrams and seismic profiles. The authors have heavily relied also on results of analogous modelling studies that have been performed at AGL over recent years.

In February 2018, the Penrose Conference was organised by the Geological Society of America on the Ein Bokekon shores of the Dead Sea (Israel); this was dedicated to the memory of Professor Martin Jackson. In his opening commemorative presentation Professor M. Hudec stressed that Professor Jackson was involved in the preparation of their book to almost the final days before his death. Unfortunately, he did not see the tome published, but his legacy takes the form of an excellently written, designed and published book that should be on the desks of experienced researchers who work with various aspects of salt tectonics and students interested in these problems alike, as well as geologists and geophysicists who study the theoretical aspects of salt tectonics and apply these data to various practical purposes. The tome reviewed here ranks without any doubt amongst one of the best text books in the earth sciences, and will remain a reference point for many years to come in the rapidly developing broad understanding of salt tectonics.

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