

Holocene Book Review

Mark D Bateman (ed). Handbook of Luminescence Dating, Whittles Publishing; Caithness, 2019; 400 pp.: ISBN 9781849953955, £??.??.

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Luminescence dating is a chronological tool which allows the direct dating of geomorphological and geological events and archaeological artefacts from the late Quaternary period (Walker, 2005). It is applicable to dosimetric minerals, such as quartz and feldspar, which are virtually ubiquitously found in the environment, and can therefore be used to date a broad range of sediments, rocks and archaeological artefacts. With a dateable age range between a few decades to a few hundreds of thousands of years, and with precision usually in the range of $\sim\pm 5\text{--}10\%$ (1 sigma), luminescence dating has become an important chronological technique used in the reconstruction of palaeoenvironment and palaeoclimate during the Quaternary Period. However, for those without training in the technique, luminescence dating may appear to be an inaccessible and impenetrable field, given that it draws from the fields of physics, chemistry and statistics simply to calculate an age, before the interpretation of that age from a geographical, geological, or an archaeological perspective has begun.

The Handbook of Luminescence Dating is a practical guide to the key principles and practicalities of luminescence dating, providing an insight into the possibilities and some of the challenges for dating across a broad range of geomorphological contexts. The book is aimed at those learning to use the technique, including under- and postgraduate students, and for those who wish to apply the technique and/or interpret luminescence data. Individual chapters outline, when relevant, some of the fundamental scientific principles from which the technique draws, however extensive discussion of the solid state physics and dosimetry fields which underlie the technique are not included. As the editor comments, there are numerous publications which deal with these principles (e.g. Aitken 1985, 1998; McKeever 1985; Bøtter-Jensen et al. 2003), and instead, this handbook provides a practical perspective aimed at researchers in the fields of Earth and Archaeological Sciences who seek to use luminescence dating as a chronometric tool.

This edited volume is organised by 12 chapters, written by research-active luminescence dating practitioners. The initial chapters provide a general introduction into the field of luminescence dating, including the historical development of the technique, taking samples in the field, and the reporting of age data. Then follows a series of chapters which relate to luminescence dating in specific geomorphological settings, including aeolian, fluvial, and glacial contexts where luminescence dating has become routinely applied and more novel settings such as marine and tectonic applications and rock surface dating, all active areas of luminescence dating research. The handbook ends with a final chapter on future developments, discussing both methodological aspects including age range extension, and examples of ways in which dating applications are currently being extended and diversified.

Whilst all chapters are slightly different in structure, for the most part they all contain a short review of previous dating studies, some of the challenges daters may face in particular environments and how these problems can be addressed, a guide to interpretation of luminescence chronologies, and in many chapters best practice advice. There is a very good balance between the process of age calculation, including sampling and approaches to measurement and analysis, and the use of luminescence based chronologies, e.g. consideration of the environmental information that dated aeolian geoproxies yield and the various ways in which archaeological contexts can be dated using luminescence. The chapters cover all the main environments

that geomorphologists and Quaternary scientists would expect: aeolian, loess, glacial and periglacial, fluvial and hillslope, coastal and marine, tectonic, archaeological, and the newly emerging field of rock surface burial and exposure dating. The type of sediments being dated feature as themes which cross-cut the chapters, and for example, the potential for dating soils is covered in the context of loess (in situ soil formation), fluvial environments (e.g. human-induced soil erosion), and archaeological contexts (e.g. terraces and irrigation features). Sediment dating (both fine and coarse grain) is a constant feature throughout, and the newly developing ability to date rocks (surface exposure and burial ages), offers an exciting view into the future diversification of luminescence dating. In all this offers a comprehensive and detailed view into the dating possibly using luminescence signals. The depth of detail provided in individual chapters and the arrangement of the volume by setting may have resulted in duplication of information, and Mark Bateman has done well as editor to avoid this. The sum is worth more than the individual parts, and whilst this means that someone new to the field may not find absolutely everything they need in one individual chapter, reading the book as a whole gives an excellent introduction to the world of luminescence dating.

To return to the main aim of the book, *The Handbook of Luminescence Dating* seeks to be a practical and accessible guide to luminescence dating for non-experts who wish to learn and/or use the technique first hand. In my view, this is achieved, and this work presents an open and honest insight into the world of luminescence dating, without being unnecessarily or overly technical. It is well-written, supplemented with useful figures, and referenced with appropriate and up to date literature. Importantly, it addresses some of the issues and challenges which chronologists are often faced with when dating a variety of samples from different sedimentological settings across the world. These challenges, including incomplete resetting of the luminescence signal, difficulties in calculating the dose rate (or the rate of radioactivity that the sample is exposed to during its burial life), and poor luminescence properties of the mineral being dated, will affect samples to a greater or lesser degree, depending on, for example, geographic location and geomorphological context. By organising the chapters according to sampling context, this work highlights some of the issues which might be expected in different dating contexts, and how these can be addressed and are overcome by luminescence dating experts. This book gives the reader an insight into how luminescence practitioners approach dating, and how luminescence ages are calculated, providing a basis for the critical appraisal of luminescence chronologies. Individual chapters offer a view into how luminescence chronologies may be used beyond simply age data, for example the integration of ages into broader chronometric frameworks (including Bayesian modelling), the calculation of sediment accumulation rates, and the use of luminescence signals as landscape evolution tools. This volume is a welcome addition to the literature, where up until now, there has not been a luminescence dating book with a focus on the practical application of the technique in a variety of settings. This book is to be welcomed for its open approach to shedding light on luminescence dating and its broad ranging uses as a chronometric tool for the reconstruction of late Quaternary palaeoclimatic and palaeoenvironmental change.

References

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