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# BOOK REVIEWS

*A Passion for Gold*: *an Autobiography.* By Ralph J. Roberts. University of Nevada Press, Reno, Nevada. 2002, 232 + xvii pages. US$29.95, ISBN 0–87417–502–X.

This is the latest in a string of geological biographies and autobiographies that I've had the pleasure to review on these pages. Much is to be learned from the careers (with their successes and failures) of those who went before us across the geological and mineralogical stage. Beware, however, for increasingly such books must be viewed as historical documents rather than professional guides for young Earth scientists of the 21st century. The Earth sciences are changing profoundly and rapidly. This is particularly true for geology, which increasingly is "developing" into a sedentary indoor science. I shall return to this theme at the close of the present review.

*A Passion for Gold* is Ralph J. Roberts's autobiography. This outstanding Earth scientist squeezes his long (he is 92) and broad life and career into a mere 232 pages, of which 44 are taken up by ancillary material. The book's title surprised me because I knew Roberts (I actually met him briefly in Saudi Arabia in 1976) as a masterful and indefatigable regional geologist. I was rather unaware of his importance to and interest in economic geology, and indeed his passion for gold mineralization. *Mea culpa.*

The book opens with a short preface where Roberts tells his readers that he was four times blessed and had the good fortune to be at the right place at the right time. He further points out that the keystones of a successful geologist are imagination, ingenuity, and flexibility of mind.

The first of the 16 chapters that follow the preface is entitled "Geology 101: Nevada Gold and Mountain Building". It provides enough geological and mineralogical background to keep the general reader on track for the rest of the book. The second chapter details the author's early life and education. Roberts began as a mediocre student at Washington State College, but upon transfer to the University of Washington, he was fired up by the enthusiasm of Profs. George Goodspeed and J. Hoover Mackin and in 1935, graduated *cum laude.* Four years later, he received a Ph.D. at Yale under the tutelage of Adolph Knopf.

The ensuing nine chapters, largely chronological, sweep through Roberts's remarkable and productive career with the U.S. Geological Survey. In a broad overview, this career began in Nevada, where later his mapping was to show that the "positive area" defined in 1928 by Tom Nolan was in fact the heretofore unrecognized Antler orogen, which is of the same scale as the Appalachian orogen in eastern North America. World War II took the author to Central America on a strategic minerals project. This was followed by a stint in the Military Geology Branch. In 1954, he returned to Nevada as head of the Eureka County Project, then moved on to Utah to the Bingham Cu–Au Project (1956–1971), and finally to Saudi Arabia on an overseas project (1971–1978). Roberts retired from the USGS in 1981.

Chapter 12 is dark. In it, Roberts poignantly describes personal tragedies: the death by drowning of his son Steven, an upcoming economic geologist, the loss of his wife Arleda to Alzheimer's disease, and his failing eyesight. The final chapters are upbeat, dealing with his post-retirement work and his 1992 remeeting of Mij Courtright, a lady he'd known 64 years earlier in high school, and the start of their new life together.

The book concludes with an appendix that outlines the lives of three USGS men (Henry Ferguson, Foster Hewett, and Norman Silberling) of particular significance to Roberts's career, a four-page glossary of geological terms, nine pages of references, and a 10-page index.

*A Passion for Gold* is a bit wobbly in its presentation. On the other hand, if it were unflinchingly linear, perhaps it would be less interesting. Surprisingly, in view of the fact that Roberts directed the Manuscript Processing Unit at the USGS for many years, is the large number of errors in the references: erroneous or omitted dates, reports cited in the text but not given in the references, wrong authors... Errors in the text are rare, but the orange on p. 3 should be an apple, and UW mysteriously becomes UC on p. 20.

Your reviewer cannot help but wonder if the title of this book is appropriate. Was not Roberts's real passion to understand the architecture and tectonic history of the upper crust? Armed with this fundamentally academic knowledge, he and other geologists have been astoundingly successful at finding gold deposits. I must here emphasize that this path to the economic well-being of our civilisation is the direct outcome of long-term and well-funded regional geological mapping by governments. Sadly, it is just this kind of work that today is being abandoned because of short-sighted decisions taken by clueless managers at the USGS (p. 194) and the GSC. Work at these organizations is now "client-oriented", or in "partnership", and what little mapping is carried out, too often is done by inexperienced folks under contract. No, Roberts's fine career came at the close of a wonderful age of real geology, where funda-

mental discoveries came from the field. So many of today's findings issue from the virtual adumbrations favored by a new generation of practitioners sitting before their computer screens. Too many of their data are reworked old data, and some may be uncertain. It is refreshing indeed to read about those who braved awful climates, snakes, daunting vegetation, horrendous topography, and (in Canada) black flies, to read the rocks and to decipher their wonderful message.

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*Krakatoa: The Day the World Exploded, August 27, 1883.* By Simon Winchester. Harper Collins, New York (Available in Canada from Harper Collins Canada, Ltd., 1995 Markham Road, Scarborough, Ontario M1B 5M8), 2003. 416 + xvi pages. CDN$39.95. ISBN 0–06–621285–5.

Only two natural cataclysmic events seem to be engraved deeply on the modern historical consciousness of mankind: Tunguska and Krakatoa. Tunguska may have been a singularity; science does not even know with any assurance what caused the devastation of so many square kilometers of Siberian forest in 1908. Krakatoa, on the other hand, was a volcanic eruption of considerable, but far from exceptional violence; a repeatable event that we, and certainly our children, shall see somewhere on Earth in our lifetimes. In fact, a far more energetic eruption took place at Tambora, on nearby Sumatra, only 68 years earlier. Even though that eruption caused world-wide hardship (the famous "year without a summer", 1816), it passed largely unnoticed for three reasons: 1) the area around Tambora was thinly inhabited and of little importance at the time, in marked contrast to Krakatoa, which lay athwart one of the world's major shipping lanes, 2) loss of life was limited, and 3) long-distance communications were slow and uncertain. It was the advent of the telegraph and a submarine cable network that spread word of Krakatoa to a news-hungry world in near real-time.

Where to begin this review? Perhaps with a warning: Geologists, do not read this book while wearing your professional hat. Instead, read it while on holiday, in a hammock, under a shade tree. *Krakatoa* is a well written, entertaining book, full of remarkable minutiae. The amount of peripheral information dragged into the Krakatoa story by the author is indeed staggering. The eruption itself begins only on page 209, more than half way through the book. The research undertaken by Winchester obviously was herculean, and is reflected by the list of 100 references (p.390–396) that he consulted. On the other hand, the wholesale absence of references to the hundreds of citations in the text and to figures will prove frustrating to the serious reader. One example of a non-reference, taken from page 109: "...which was published in an otherwise obscure book in 1980, that it is "subduction along the Java Trench, where the Indo-Australian Plate [*sic*] is moving under the Indonesian Island chain that fuelled the 1883 eruption of Krakatoa". Worse, perhaps, is the inadequacy of the maps, especially "Southeast Asia/Indonesia" (p. x), which shows the locations of few of the places crucial to the text (Anjer, Java Head, Bantam...even Krakatoa itself!), and presents a confusing mish-mash of intersecting lines. Map scales, where given, are in kilometers (bravo), but distances in the text all are in miles.

It is, however, on the geological/mineralogical side that *Krakatoa* comes to pieces. This is particularly surprising because the author holds a degree in geology from a prestigious university. That aside, the author's grasp of the plate-tectonic paradigm is shaky at best, and downright erroneous in places. No, it wasn't Tuzo Wilson who came up with the hotspot idea (currently under restudy), but Prof. Jason Morgan. No, not all volcanic activity is related to subduction zones or oceanic ridges; the most devastating may emanate from intraplate tensional environments.

Geological stumbles are numerous. In nearly all respects, the rocks of Java and Greenland are dissimilar, yet the author (who has been to Greenland as well as Java) tells us: "...geologically the two places have a good deal in common...Both Greenland and Java are volcanic places" (p. 82). Tephra is not "Erupted boulders and lumps of partly congealed lava..." p. 241). "Did the eruption [of Krakatoa] lower the world's temperature? Or did a lowering of the world temperature because of some other reason perhaps – unthinkable though it seems – somehow prompt the crust to undergo stress and strain and crack, and a rash of volcanoes to explode?" (p. 291) is reminiscent of the Jupiter effect or similar new-age nonsense.

Geophysics and mineralogy fare no better. The author's recounting of rock magnetism is wrong, and the drawing of a magnetite crystal (p. 83), which more resembles gypsum than magnetite, is as ludicrous as is its caption: "A crystal of magnetite, usually aligned with the poles along its long axis."

Summer is winding down as I write this review at a rented cottage on the south shore of the magnificent estuary of the St. Lawrence. It was just the right setting in which to read this engaging and nicely written book. A soft, dreamlike atmosphere, distant from the realities of my field area or of my office upstream at the université. Voilà.

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*Minerals in Thin Section* (2nd edition). By Dexter Perkins and Kevin R. Henke. Prentice-Hall, Upper Saddle River, New Jersey 07458, U.S.A. Available in Canada from Pearson Education, 195 Harry Walker Parkway N., Newmarket, Ontario L3Y 7B4, 2004, 163 + xi pages, paper. ISBN 0–3–142015–1.

Why do mineralogists and geologists take time and expend effort to review books in their field for publication in widely read professional journals such as *The Canadian Mineralogist*? On the one hand, the exercise is to make known and praise outstanding and useful books. On the other, it is to pan books of little or no merit, all pointing out their weaknesses and exposing their errors.

Who reads these reviews? Apparently neither authors nor publishers of books in the second category. I reviewed the first edition of *Minerals in Thin Section* on these pages three years ago and found the book inadequate. Furthermore, I listed dozens of serious errors and shortcomings that it holds. *Voilà*, the second edition here under review is practically identical to the first; basically it is a simple reprinting. None of the shortcomings that I listed have been addressed, and of the errors, only two, both strictly typographical, have been corrected. The scientific and technical mistakes are carried through, and not one has been set right. Accordingly, and to save space, I suggest that those who wish to consider this book read my review of the first edition (*Can. Mineral.* **39**, 216-217).

So, how does the second edition differ from the first? Right off, one notes that the number of pages has swelled from 125 to 163. Beware gentle mineralogist, this is sleight-of-hand! The plates, not paginated in the first edition, now are, with two fresh ones (plates 9 and 10) of "Minerals in sedimentary rocks" having been added. Also new are two "boxes" (9 and 10) on the feldspars, including rudimentary charts for the determination of plagioclase compositions by the Michel-Lévy method, and small charts that relate compositions of orthopyroxene (p. 66) and olivine (p. 79) to selected optical properties. Another novelty is afforded by crystal drawings, joined to the descriptions of nearly all the anisotropic non-opaque minerals, that relate crystallographic and optical orientations. Although well-intentioned, the drawings are just too complex for the level of students who use *Minerals in Thin Section* as a basic text. Even though the construction of the crystal drawings in explained (p. 48), they are more likely to confuse than to assist.

Finally, like the first edition, the second is spiral bound. Whereas the first opened easily and lay flat, the second edition has a double spiral, which tends to bind upon closing. The book risks becoming dog-eared with relatively little use.

My conclusion is unchanged from that which I gave for the first edition: I cannot recommend this book. The theory is inadequate, and the mineral descriptions are unsatisfactory. *Minerals in Thin Section* more resembles a commercial product than a serious scientific text.

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*Polarized Light Optics*: *the New Physics of the Photon*. By David K. Teertstra, c/o Euclid Geometrics, Publishing, 843 Queen's Boulevard, Kitchener, Ontario N2M 1A6, (519) 578–0818, en369@ncf.ca, 2003, Handbound, 196 pages, 101 figures, CDN$107. ISBN 9686314–3–6.

By any stretch of the imagination, this is not a "normal" book, but what would one expect from the author of *Geometric Floor Tile Design – Do-It-Yourself Custom Patterned Flooring,* which was also reviewed in *The Canadian Mineralogist* (**38**, p.1492). The book is handbound, and the cover is original artwork by the author. My main research interest in mineralogy continues to be in the interaction of light with minerals (*i.e.*, optical mineralogy), so I was very interested in reading this book. As most of you know, there is the classic debate about whether light is a wave or a particle, and this book claims to provide a "unified wave-particle" theory of light. I was also intrigued by the last chapter in the book, in which the author describes how to determine the crystal structure of minerals based on light refraction.

In the Prologue, the author sets a writing and thought style that reminds me of *Zen and the Art of Motorcycle Maintenance*; in fact, possibly the book might better be titled *Zen and the Theory of the Unified Photon.* As an example, there are such simple statements as "I want to know how light gets through glass" followed shortly by "The Plank dimensions are now cracked open so that the Heisenberg uncertainly principle has lost its philosophical ramifications and is placed on a sound determinate physical basis." It is also in the Prologue that the author proposes that the photon has mass. However, the author states that his new theory will no doubt need future modifications, as do all new theories.

The author is very well educated in the Canadian University system as a research mineralogist (which he documents in the last section in the book), and has considerable industrial experience in the optics field. This background causes him to make observations like "educators want everyone to know how things work, but manufacturers need to keep their trade processes secret. But since my work in optics is not paid for by taxes or by a company, you will have to buy the book to get the theory." Thus, my goal here is to review his work and not provide details of his unique thoughts on optics.

The book is broken into four sections and twenty-four chapters. At the beginning of the book the author develops much of the background information he will use to arrive at his new theory. Also, in these early sections, he disregards the wave theory of light that is commonly used to explain optical phenomena based on constructive and destructive interference of light waves, such as is commonly used to describe the formation of interference colors. Unfortunately, much of the time I felt more like I was reading a historical/philosophical view of Einstein, Heisenberg, Plank, Snell, and all of the other physicists who have tried to understand light. Such statements as "It is not enough to pay heed to the philosophic truth, that the word is not the thing and the image is not the object" reinforces this feeling. These statements seem out of place in an optics book and more Zen-like, which might not be bad.

I became somewhat tired of reading about the historical aspects of quantum mechanisms; there's much more discussion of it in the book than optics, at least what I would term as optics. However, much of this background quantum mechanical theory was needed so that the author could develop his theory on atomic thermodynamics and the photon. Much of his premise on his new unifying theory deals with the interaction of the mass-based, charged (both + and –) photon with electrons and clouds of electron density. He spends considerable time discussing photon refraction; remember, he does not deal with wave refraction in the classical sense. Snell's refraction is explained by photon refraction, where waves are not bent, but photons follow non-linear paths.

What kept me reading through the "dense" physics portions of the book was the anticipation of the chapter entitled "Refraction and Structure." In this chapter, he builds upon his new theory, the Gladstone–Dale relationship, ion sizes, and photon refraction to propose a method to determine the crystal structure of a material by light (*i.e.*, photon) refraction. Much of this idea is based on his proposed properties of the photon and how the photon undergoes refraction. He provides a worked example of how to calculate the ionic sizes of atoms based on the Gladstone–Dale constants, and his results are in agreement with what are normally accepted ionic radii. However, with this method one is actually measuring an electron density contour that corresponds to the energy of the input photon.

One last quote: "Few people enjoy the sequential process of calibrating index oils and determining index of refraction by immersing grains in oil." I am one of those few people, and synthesizing the ideas presented in this book has given me new insights on how we might use some of these basic optical properties of minerals to better understand the structures of materials. Finally, I'll agree with the author that you should buy the book to fully appreciate his treatment of optics from a philosophical, historical, and practical viewpoint. You can also only then see how he graphically models a photon with multi-sheathed hair and what the hair rules are.

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*Handbook of Mineralogy*. V. *Borates, Carbonates, Sulfates*. By J.W. Anthony, R.A. Bideaux, K.W. Bladh and M.C. Nichols, Mineral Data Publishing, Inc., P.O. Box 37072, Tucson, Arizona 85740, U.S.A., 2003, ix + 813 pages, US$130 plus US$15 shipping and handling (US$ 20 outside U.S.A.); members of MAC are offered a 20% discount, hardbound (ISBN 0–9622097–4–0).

Here is volume V, concluding a series describing all named mineral species and a resting point in a monumental compilation of mineral data. Earlier volumes have been reviewed (**29**, 175–176; **33**, 1155; **36**, 232; **38**, 1487), and few details need be repeated. The authors "gather in convenient form the data crucial to identification of all mineral species" (v). In alphabetical order from abelsonite to zugshunstite, each of 791 minerals is treated on one page: name, formula, crystal, physical and chemical data, polymorphism and series, mineral group, occurrence, association, distribution, origin of the name, type material and selected references. Following the minerals is an index listing all species in the five volumes alphabetically with a volume number for each on pages 793 to 813. Major points are consistent accuracy of data, parsimony of information. Previous reviews of this series have discussed aesthetics and alternative orders of presentation, such as mineral groups. In common with earlier volumes, errors of any sort here are scarce. This reviewer noticed only a handful of typos and only insignificant "errors", such as a mineral listed in its own Association, or discordance between Occurrence and Association.

Listings in volume V are up-to-date to late 2002. Where formulae are changed from other works, this is based on new crystal-structure determinations (quetzalcoatlite is an example). Unfortunately, there is little critical analysis of the data. On occasion, the authors seemingly could not resist a suggestion, usually in the form of a calculated chemical analysis with implied corrected formula, as in mackayite and oxammite. Are they suggesting a series between wulfenite and stolzite?

One page of data will allow a reader to test a mineral name given to a specimen, but alphabetical ordering of minerals will not help to find that name. Minerals listed in Association may be helpful in tracking down an unknown, but Distribution will see less use, as the price of these volumes puts them out of reach of most collectors. A particularly welcome feature is a calculated ideal chemical composition for most species, which allows direct comparison with published data.

A compilation such as *Handbook of Mineralogy* by its very existence marks a turning point in the way mineral data are assembled and made available. With some 50 new species IMA-approved each year, no physical book can remain current for research. Update volumes would be a stopgap; electronic media will likely carry on from here. Hopefully new forms of communication will continue with the Handbook's approach of consolidating diverse subdisciplines such as crystallography, chemistry and geology (occurrence and mineral associations).

Even our perceptions of mineralogy are changing. We now conceptualise in terms of mineral groups, structural hierarchies and variations within groups through substitution at sites. A work based on the species concept, *Handbook of Mineralogy* is likely the summit of its kind.

As a rapid, systematic and especially accurate source of data, *Handbook of Mineralogy*, all five volumes, should find a place in every mineralogy laboratory.

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*Techniques in Archaeological Geology.* By Ervan G. Garrison. Springer-Verlag London Ltd., Sweetapple House, Cattleshall Lane, Godalming GU7 3DJ, U.K. (Natural Science in Archaeology Series), 2003, 304 pages. US$95, hard cover (ISBN 3–540–43822–X).

This volume in the Natural Science in Archaeology Series is an overdue addition to the bookshelf of Earth scientists with an interest in archeology, and archeologists who are interested in the Earth-science-based techniques applied to archeological sites, features, and artifacts. Comprehensive and up-to-date books surveying these topics are few and far between. Whereas it is impossible to go into depth on any one topic in 300 pages, the author does a respectable job of covering the basics in a succinct and easy-to-read manner. The text should serve as a useful reference and starting point for anyone wanting to investigate the currently available and applicable techniques for a particular archeological site or problem. Those unfamiliar with geological terminology should have no trouble with the minimal, but well-explained, technical jargon. In layout and style, this work is similar to an earlier volume in the same series, *Age Determination of Young Rocks and Artifacts* by G.A. Wagner (1998).

Following a short introduction to the topic of archeological geology (Chapter 1) are seven chapters, each with a specific theme. Chapter 2 covers the recognition of geomorphic settings, landforms and the environments that created them, and survey and mapping techniques, from regional scale to local and site-specific. Where possible, examples are given of how environment affects archeological sites. Thus the section dealing with glaciers uses the Rhoads site in Illinois to describe how the paleoenvironment created by the advance and retreat of ice impacted on postglacial human populations in the area. The section on mapping techniques provides an introduction to the various techniques used to create maps, and the various types of maps that one might encounter or find useful in an archeological context.

Geophysical techniques is the subject of Chapter 3, and the author clearly states in the first paragraph his intention to familiarize the reader with the range of common shallow geophysical techniques and their possible uses in archeology. Electrical (resistivity) and magnetic methods are covered, as well as radar and underwater (*e.g.*, sonar) techniques that are starting to be used by archeologists. Advantages and drawbacks of each method, and examples of what types of data can be created, are given for most of the techniques discussed. This is useful information for the researcher deciding which of these methods, expensive as they are in some cases, are best for surveying a particular site.

Chapter 4 discusses techniques of field sampling in regards to sediments and soils within an archeological context. The chapter begins with an introduction to soil nomenclature and taxonomy, and the terminology applied to soil horizons. The specific description of soils in profile follows, with color, texture, pH, organic matter content, and soil strata each addressed in turn. It is important to note that although the American and French taxonomic classification systems are discussed, the system used in Canada is not. Sampling methods and coring are the final topics in this chapter. Coring equipment exists for every possible circumstance, from simple hand augers to rotary augers and drills. The available techniques are described, and the environments where they are best suited are given. Profile exposures are as important today as they were when Sir Mortimer Wheeler first introduced the study of site stratigraphy many decades ago. Indeed, one of the first lessons learned by all field archeologists is how to produce a vertical profile. I remember my great-uncle, the late Dr. L.D. Mallory, checking baulks with a level, and woe betide the student whose square did not have perfectly vertical walls! Soil profiles are sampled with monoliths that create a small section of the profile, or peeled with synthetic latex to remove a small amount of material from the exposed surface. Both these sampling techniques require finesse and practice, and are not as simple in reality as the author describes. Analytical techniques applied to soil samples are given in the following chapter. Sediments and soils from an archeological context can give important details of the paleoclimate, may contain artifacts, floral or faunal remains, and can in some cases be used for dating purposes. The author concentrates on

aspects of the first two subjects, breaking the analysis of sediments into the "five Ps", particle size, point counting, palynology, phytolith, and phosphate procedures, and covering each one in turn.

Petrography for archeological geology is the longest chapter (6) in the book, the bulk of which is devoted to a survey of the various rock-types, how they are classified, and recognized in hand specimen and thin section. The examples of where different rocks occur in an archeological context, either in architectural features or as the material used to manufacture artifacts, are in some cases surprising, for example, tuff vessels employed as grave goods in ancient Egypt. Whereas the geologist may have no trouble envisioning what minerals look like in thin section, a few color plates illustrating birefringence, pleochroism, twinning, fundamental textures, *etc.*, would have been helpful for the non-specialist. There is a glitch in the text on p. 163, where Fig. 6.2 rather than 6.1 is said to show twinning in feldspar. The final topic in this chapter is the well-published area dealing with the application of petrography to pottery and ceramics. An example drawn from one of numerous studies showing how it can be applied in practice would be illuminating for those not familiar with this area. A third book in the Natural Sciences in Archaeology Series, *Archaeomineralogy* by G.R. Rapp (2002), deals with archeological applications of mineralogy, and these topics may be covered in more depth there.

A wide range of instrumental analytical techniques are surveyed in Chapter 7. Each technique is grouped by its general operational principles (*e.g.*, spectroscopy, fluorescence, spectrometry, *etc.*). The key issues related to the analysis of artifacts, sample size required, precision and accuracy, availability and cost, are briefly discussed. Whereas geologists rarely need to consider the value of samples, this is commonly of prime concern to the archeologist where a destructive technique is being considered. It is heartening to see that the author has emphasized techniques that require minimal amounts of material, including the relatively new LAM–ICP–MS technique, which is, for the most part, unknown to archeologists. The issue of instrument availability and cost is also addressed. Both archeologists and geologists will find Figure 7.14 useful, as it is a handy illustration of the detection limits for the more common analytical techniques. The chapter ends with a discussion of the issues surrounding the destructive analysis of human remains, a subject lately in the news in relations to Kennewick man, but also one with which the individual researcher must at some point come to grips.

The final chapter covers the application of statistical techniques to data using a number of archeological examples. Although some methods (*e.g.*, t-tests, least-squares analysis, linear regressions) will be familiar to the Earth scientist, others, in particular multivariate exploratory techniques, will not. Principal component analysis and cluster analysis have long had a place in archeology, but are rarely applied to purely geological problems. Discriminant analysis is less common. The brief introduction to these methods may suggest ways that they can applied to Earth science problems.

In summary, this is a useful reference book for both the archeologist and geologist. Perhaps its one shortcoming is that dating techniques are not covered, but the companion volume in the series covers this topic in greater depth than would be possible in a survey work. For an undergraduate course in a geoarcheology, this would be a useful textbook, as it is written at a level that most upper level undergraduates should be able to understand. However, for completeness, one would need to cover dating techniques with supplementary material.

## References

RAPP, G.R. (2002): *Archaeomineralogy*. Springer, New York, N.Y.

WAGNER, G.A. (1998): *Age Determination of Young Rocks and Artifacts*. Springer, New York, N.Y.

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