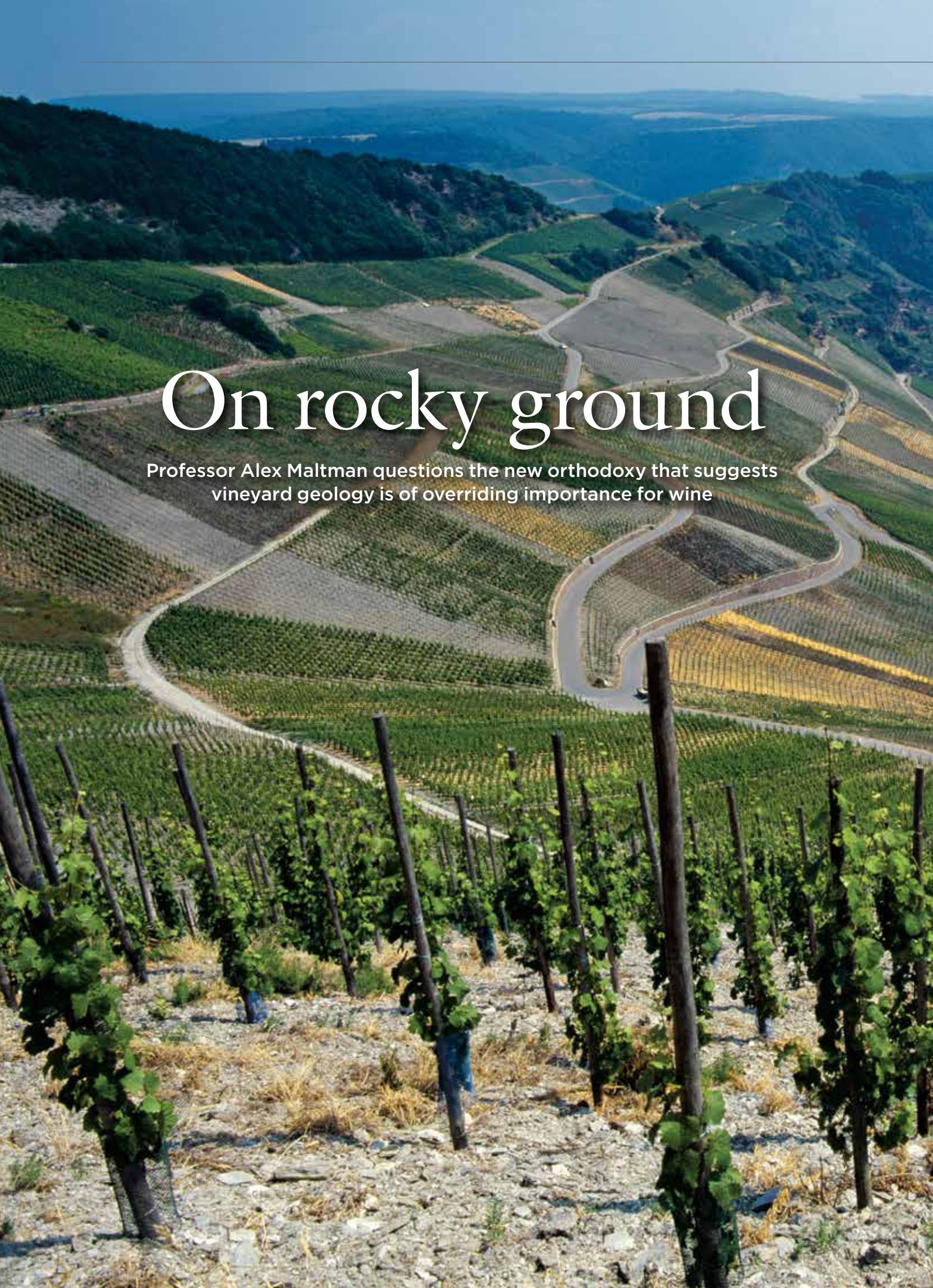


On rocky ground

Professor Alex Maltman questions the new orthodoxy that suggests vineyard geology is of overriding importance for wine

The view south over the Mosel river from the Falkenberg vineyard at Piesport, Germany, with its slopes of Devonian slate

I SHOULD BE jumping for joy. For years I've taught, researched and generally enthused about geology and its importance, and now my subject is making headlines in the world of wine. 'Soil, not grapes, is the latest must-know when choosing a wine,' Bloomberg tells me, for example. So why am I not full of joy? Well, because as a scientist I have to follow the evidence, and this leads me to query this new pre-eminence of vineyard geology.

Of course, a link between wine and the land has long been treasured as something special. It even survived the discovery of photosynthesis – that vines and wine are not made from matter drawn from the ground but almost wholly of carbon, oxygen and hydrogen, abstracted from water and the air. The rocks and soils in which the vines grow are certainly still part of the scientific picture, but this pre-eminent role is something new.

Today there are restaurants with wine lists organised not by grape, wine style or country of origin, but by vineyard geology. Alice Feiring's book *The Dirty Guide to Wine* urges drinkers to choose their wines by 'looking at the source: the ground in which it grows'. There's a consortium of growers from such diverse places as St-Chinian, Alsace, Corsica and Valais that claims commonality of its members' wines simply because their vines are growing on schist – even though schist and the soils derived from it are incredibly varied. The same could be said about the very fashionable idea of (so-called) volcanic wines.

Yet in none of this are we told what the geology actually does, how a particular rock brings something special to the wine in our glasses. And our present scientific understanding makes it difficult to see how this might happen. The fact is that the claims are largely based on anecdote: the science suggests that the vineyard rocks and soils have more modest roles.

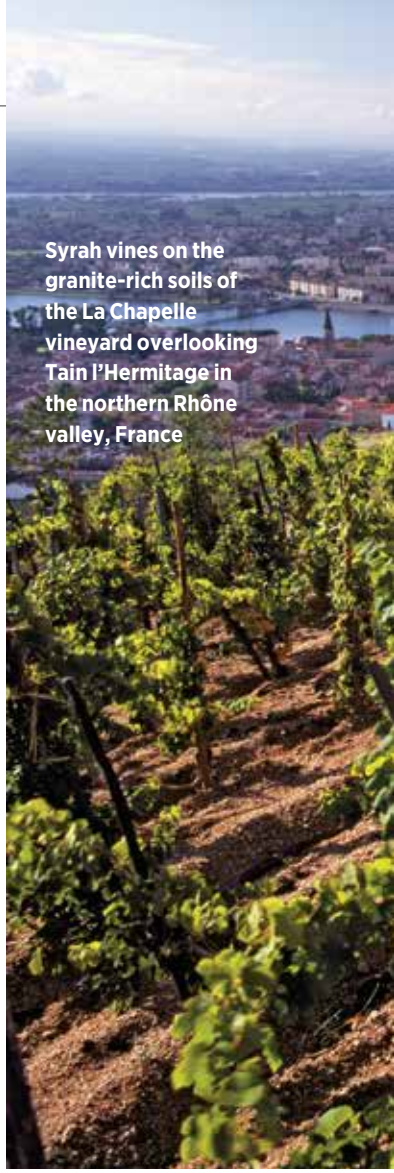
Questionable claims

So what are their effects? Well, quietly in the background the bedrock geology sets the context by determining the physical landscape. The resistance of different rocks to erosion governs where hills and plains develop, where we get favoured sites for vineyards such as hillsides and river valleys. But the major direct contribution of geology, consistently confirmed by research in various parts of the world, concerns water supply: providing decent drainage for the vines while storing sufficient water for dry periods. It's pivotal to how grapes swell and ripen.

However, many different kinds of geological materials fulfil this – gravels in Bordeaux, for example, granite soils in the northern Rhône, chalk in Champagne. Moreover, growers routinely attend to any shortcomings by inserting drains and, in most parts of the world, irrigating. That is, the role of the natural geology is overridden.

How the vine roots are warmed by the soil plays a role, but a particularly popular claim is that the rock of some particular vineyard provides an advantage through being heated during the day and re-radiating warmth to the grapes at night. However, the scientific data show that this capacity varies little between differing rock types – all of them do it, provided the ground is bare – and that it's not a very great effect anyway. It's probably only significant in some cool-climate areas where the grapes are trained close to the ground. And anyway, there is a school of thought that finer grapes are produced where night-time temperatures are markedly cooler than during the day.

The feature of vineyard geology most often mentioned relates to it supplying the nutrition needed by growing vines. It's often made to sound as though vines simply soak up whatever nutrients the local geological materials yield, and these are then conveyed through the vine to the eventual wine. We read, for example, that 'the vine transmits its nutrients all the way from the stony soils to the final wine' and 'the vines sip on a cocktail of minerals in the vineyard soil, for us to taste in our wineglass'. Some statements even suggest that the rocks themselves are making it through to the wine, as in 'the weathered Devonian slate is right there in your glass'. Sadly – I suppose – scientific understanding of how vines grow means this kind of thing just doesn't happen. To explain, let's look at some aspects of how vines and soils work.



Syrah vines on the granite-rich soils of the La Chapelle vineyard overlooking Tain l'Hermitage in the northern Rhône valley, France

'It's really the rootstocks onto which vines have been grafted that interact with the soil'

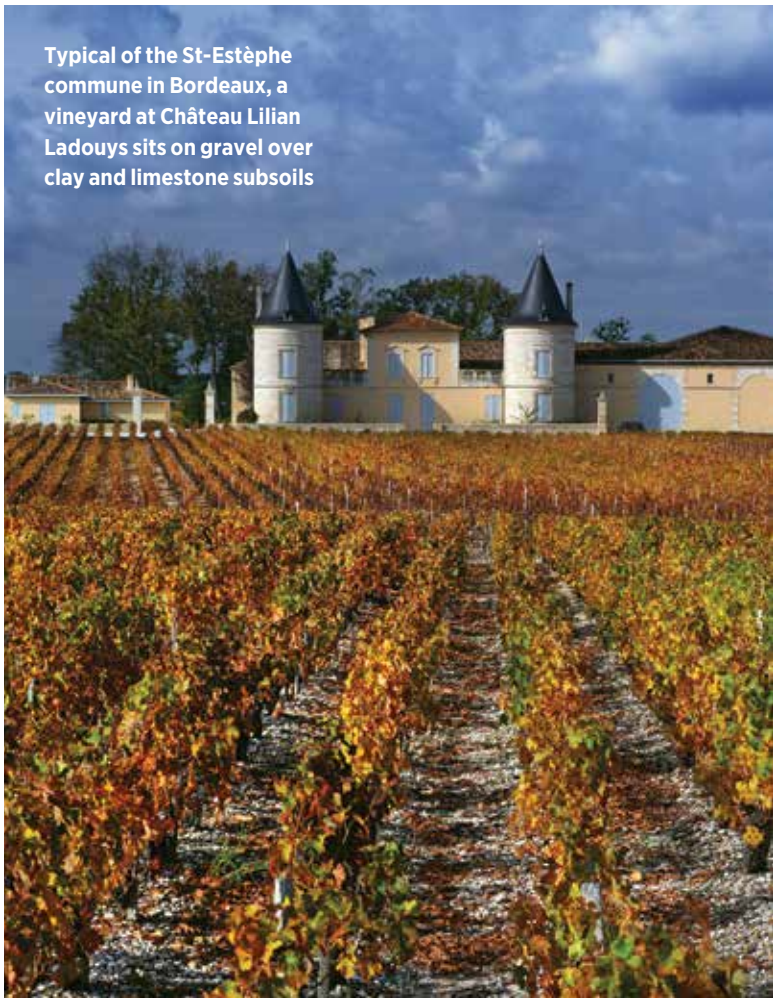
Photographs: Mick Rock/Cephas (7)

Mosel grey slate

Champagne chalk

Priorat schist

Châteauneuf-du-Pape galets



Typical of the St-Estèphe commune in Bordeaux, a vineyard at Château Lilian Ladouys sits on gravel over clay and limestone subsoils

Elemental concept

By nutrition, we mean the 14 elements that a vine needs – besides the carbon, oxygen and hydrogen – in order to grow. Most of them are metals, things like potassium, calcium and iron, and in the first place these are locked inside the geological minerals that make the rocks, stones and the soil's physical framework.

It's easy to demonstrate that these nutrients have to be in solution in order for the vine to absorb them – just scattering iron filings, say, on the vine or on the ground doesn't do much good. Vine roots simply cannot absorb solids. But a series of intricate and complex weathering processes can release some of these elements from the parent geology, and enable them to become dissolved in the soil water that is adjacent to the vine roots.

But these processes are slow, too slow to be able to provide each growing season a replacement set of nutrient minerals. And this is where humus – decayed organic matter – comes in. Every farmer and gardener knows that they can't keep harvesting crops year on year without enriching the soil. With the unusually modest nutritional needs of a ➢

grapevine, the humus need only make a small fraction of the soil, but it has to be there.

Among other things, humus is able to recycle nutrients, it's interlinked with organisms beneficial to the soil, and it is the only natural source of essential nitrogen and phosphorus, which are lacking in most rocks. The rock debris in the vineyards of the Mosel, Priorat or Châteauneuf-du-Pape may look hopelessly barren, but around the vine roots there's humus.

So, to caricature the point a little, if you perceive a taste of minerals in your wine and say this is due to the vineyard ground, then you should be thinking not in terms of limestone, slate, granite, etc, but of decayed vegetation.

On the uptake

Another matter often overlooked is that even if the nutrients are available in the soil pore-water, they are not necessarily absorbed by the roots. All organisms require nutrients in particular proportions, but whereas animals like ourselves ingest them in bulk and have internal mechanisms (liver, kidneys etc) to sort and expel the excess as waste, plants such as vines regulate them on the way in. How? Put simply, the vine has an armory of sophisticated mechanisms aimed at selecting and balancing its nutrient uptake as required, even varying it as the growing season progresses. There is some passive uptake of elements and the selectivity mechanisms are far from infallible, hence nutrient imbalances can arise, but these are routinely checked for by a conscientious grower and corrected as necessary.

Certain vine cultivars are often said to suit particular rocks: Chardonnay and limestone, Syrah and granite, for example. But much of this derives from the geology that happened to be where a cultivar first flourished; Syrah and Chardonnay thrive today in many soil types. In any case, it's really the rootstocks onto which they have been grafted that interact with the soil. We may be au fait with the various Cabernets and Pinots, and even the different clones of Sangiovese and Malbec, but to many of us 140 Ruggeri, Kober 5BB, 1616 Couderc and the like are an alien world.

The nutrients are taken up by the vine because they are essential to its growth processes but, although it may seem a truism to say so, their actual source is irrelevant. The vine does not care, so to speak, whether a particular nutrient mineral originated in this or that geological mineral, in humus or in a bag of fertiliser. Magnesium is magnesium irrespective of its source and does the same jobs.

The proportions of these nutrients change substantially during vinification, though some of them may survive through to the finished wine. But the amounts are tiny: a typical wine has only around 0.2% of inorganic matter in total, and it's pretty much tasteless anyway. Salt, sodium chloride, is an exception, but grapevines try to prevent the uptake of sodium, and hence most wines contain less salt than the minimum required in order for us to detect it even in plain water. An important point, however, is that the presence of these nutrients in wine can indirectly affect a range of chemical reactions and thereby influence our taste perceptions. But these are complex and circuitous effects, a long way from vineyard geology dominating wine.

Out of sight...

The apparent importance of vineyard geology has been bolstered by the fact that we commonly use geological words to communicate taste perceptions, as metaphors. We may, for example, report a flinty taste in wine (especially if we know there's flint in the vineyard ground!). But flint lacks any taste or odour, and being a solid compound is unavailable to vine roots. We are probably recalling the smell produced by striking lumps of flint together, which has a chemical cause irrelevant to vineyards. There are similar

'The vine has an armory of sophisticated mechanisms aimed at selecting and balancing its nutrient uptake'

Below: the Grand Hill subsection of Abacela's Cobblestone Hill parcel at its Fault Line Vineyards in Oregon, where the geology comprises a complex mix of metamorphic, sedimentary and volcanic soils

chemical and biochemical explanations for such perceptions as an aroma of wet stones, tilled earth, sea-shells or a metallic taste.

Where identically made wines from nearby sites taste differently and the soil differs, it's easy to pounce on the soil as the explanation. It's right there, palpable and familiar. But there will be other factors at play in a vineyard, well known to influence wine character but which are invisible and hence overlooked. Fine variations in climate, for example.

The land at the Fault Line Vineyard at Abacela, in Oregon's Umpqua Valley, shows variations in soil types over small areas and similar changes in the wines. Here, however, the owners collected meteorological data from 23 different spots within the vineyard, every 15 minutes, for five years. This revealed unexpected variations in such things as intensity of solar radiation, and temperatures during the ripening period differing by nearly 5°C – all within this single vineyard. On their concluding list of factors that influenced grape ripening, soil differences were not high.

Work in progress

There has been excitement in scientific circles in recent years about the possible importance of microbiology in the vineyard, because new technologies have revealed distinct fungal and bacterial communities at different sites. What effect this has for wine taste is at present unclear, but since the kingdom of fungi includes organisms such as the mould botrytis and the yeast brettanomyces, it could be very important. However, perhaps because all this is unseen and it's all technical stuff, lacking the apparent charisma of geology, such things are avoided in most wine publicity.

So in view of all this, is it enough just to make grand assertions about geology without offering a basis? Saying, for instance, that an Austrian Riesling has 'complexity because of the slatey para-gneiss, amphibolite and mica soils' may sound impressive, but surely some indication is needed on how this works?

Of course, it's perfectly possible that science is missing something. And I will be delighted if someone points out some significance of the vineyard geology that I haven't considered. I've long been trying to highlight how geology underpins so many things in our modern lives; if I knew how I could do it for the taste of wine, then I'd be overjoyed. D

Alex Maltman is an Emeritus Professor of Earth Sciences and author of Vineyards, Rocks & Soils: The Wine Lover's Guide to Geology *(Oxford University Press, May 2018)*