Preface

What is an extreme environment? For humans, this probably amounts to environments that would not allow them to live comfortably in, such as the bottom of the oceans, the south Pole, and the middle of extremely hot deserts. For a microbe, it is a different story. A temperate soil subjected to daily freeze-thaw cycles in the spring might be more extreme than permanently frozen soils in northern Canada. Otherwise, nonextreme environments that are subjected to constant human perturbations can become extreme for microbes (see Chapter 4 for a compelling case by Howard et al.).

But is the study of microbes occurring in extreme environments fundamentally different from the study of microbes occurring in more temperate settings? In most cases, probably not, and the techniques presented in this book can probably be applied to other environments as well. However, extreme environments do have some peculiarities. For one, they are generally less well studied than other types of microbial habitats, making the identification of genes and taxa more difficult when relying solely on molecular techniques. This has not stopped numerous researchers to perform such molecular-based studies in extreme environments as reviewed by Cowan and colleagues in Chapter 5. Along the same lines, in Chapter 6, Tremblay describes a modular analytical pipeline that can analyze sequencing data of any kind and can accept most databases for annotation. This approach was successfully used to characterize microbial communities in extreme environments, like ice, arctic soils, and extremely polluted soils, but was also shown to be useful for microbial communities in less extreme environments. Advanced isolation techniques, as comprehensively reviewed by Marcolefas and colleagues in Chapter 1, might help bridge the abovementioned gap by allowing more studies on isolated "extreme" microbes. Isolation and characterization are also prerequisites for the use of these microbes in industrial settings. Indeed, in Chapter 3, Schultz and Rosado show that extreme environments have been an almost inextinguishable source of microbes, genes, and protein that have desired characteristics for various industries.

Another key difference between temperate and extreme environments is that the latter environments are often so extreme that extracting molecules and microbes from the environmental matrix can become challenging. In Chapter 2, Choe and Lee expand on techniques to study microbes in rock and their habitats and show that even these microbes can be studied using modern techniques drawing from both the physical and biological sciences. One could also imagine that environments with extreme salt or pH values can offer challenges for the extraction of nucleic acids or other molecules using traditional methods.

Finally, in these times of global climatic changes, there is a need to understand the drivers of diversity, and I argue that extreme environments could be used as model

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for that purpose. In Chapter 7, Moroenyane and Yergeau review available statistical techniques to study microbes in extreme environments, with a focus on understanding microbial diversity. I hope that this book will help students and established researchers to have an idea of the most advanced techniques available and of their peculiarities when applying them to study microbes in extreme environments.

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