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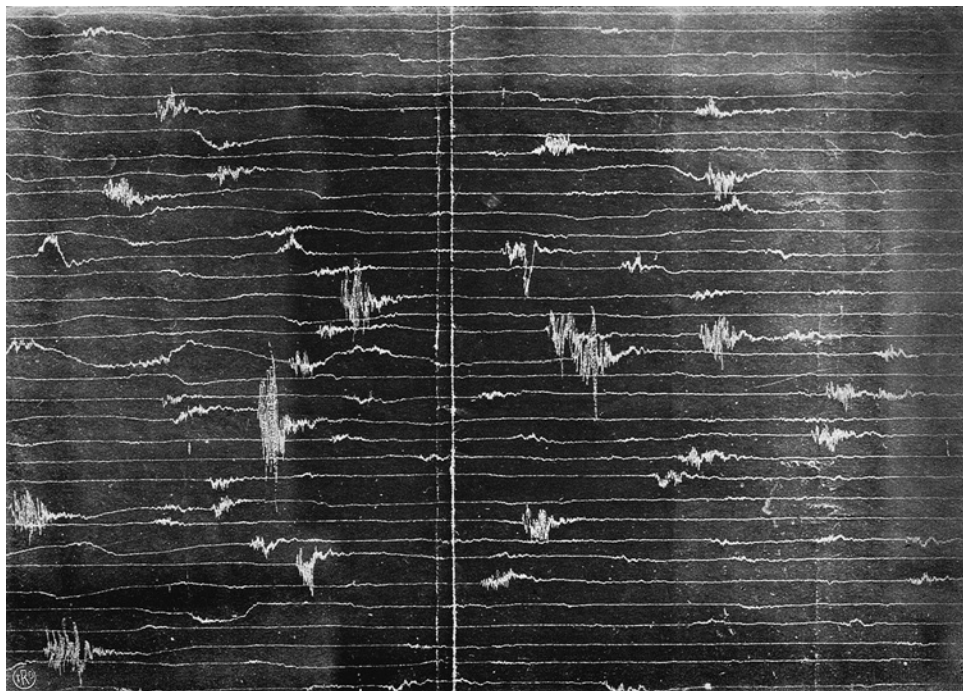


THE
PULSE
OF THE
EARTH



POLITICAL GEOLOGY IN JAVA

THE PULSE OF THE EARTH



Seismograph recording from an eruption of Merapi volcano, November 23–24, 1930.
Vulkanologische en Seismologische Mededeelingen 12 (1933): 138.

ADAM BOBBETTE



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Thank you Giyono, Suparno, and Sukidi

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PREFACE

THE MODERN EARTH WAS MADE IN JAVA · We—as in the *we* who believe that the earth is broken into tectonic plates that glide across the surface of the earth and grind into each other, and that the ocean floors are bisected with massive trenches that ooze the stuff that makes continents—we inherited these stories from Java. Our orthodoxy, the taken-for-granted scientific picture of the history and structure of the earth, was forged on the slopes of Javanese volcanoes as scientists watched them shudder, explode, crumble, turn to dust and ash, and wash into the oceans. Scientists photographed the remains of houses cracked by earthquakes, then they circled smoking calderas in airplanes, hid in bunkers, peered from prison lookout towers, trekked through forests of giant ferns and pine trees growing from volcanic soils. It was in these volatile, rambunctious landscapes that a new, modern story of the earth was forged; a story that stressed how the earth was formed under duress, a system of creative destruction, a surface remaking itself in deep time—buckling, crushing, and reemerging from its own split seams.

Java has been, for more than a century, an intellectual center for earth narratives. These narratives were built not only by Western scientists conducting work in Indonesia but through uneasy and complicated collaborations between mystics, colonial Christians and Muslims, Sanskritists, ethnologists, antiquarians, occultists, postcolonial revolutionaries, and ethnonationalist animists. Earth stories were cosmic stories, told with one foot on a caldera and the other on the ruins of a Hindu temple. Volcanologists carried binoculars and tilt meters, guns and oblations;

they prayed to ocean goddesses and mythical jihadist serpents in craters. We inherit this past, it made the earth we now know.

When we imagine that the Anthropocene is an unprecedented moment, shocking because humans are now acknowledged to be participating in processes as ancient and soundly inhuman as geology, we actually *should* be surprised by how little we have understood of geology and how late many of us are to the game. The Anthropocene is revolutionary only for a small few, often scientists and humanists in Western metropolitan circuits. But the core problem of the Anthropocene has been central to modern geology for more than a century, and it was crucial from the beginning in Java. How humans are or are not implicated, and to what degree of profundity (how ontologically deep), in geological processes was the prevailing metaphysical riddle for geologists there. The question was asked with a special intensity even before colonial geologists began extensively mapping the island for the first time in the late nineteenth century. Societies in Java were traditionally ordered on the principle that geology was social, that social history was geological history, and that volcanoes were societies. Modern European geophysics was built amid this expansive conception of the sociality of geology, and European colonists were fascinated by it; they learned how to understand the relationship between geology and society from it. Standard Western geological science was not simply imposed on a prior indigenous geology; instead, Native and colonial geological knowledges produced each other, even if the process was uneven, indirect, and sometimes violent. And now they contain each other. The Anthropocene was theorized with profound intellectual and political intensity in Java long before it became of interest to contemporary Western scholars.

Acknowledging that society was considered geological in the Javanese geological sciences goes some way to pluralizing the intellectual traditions that have helped shape contemporary theories of the Anthropocene. Much Anthropocene theory remains unfortunately bound up with histories that continue to center Western science at the expense of its much more plural and cosmopolitan origins. While geological theory is currently seeking to identify the material markers of the Anthropocene, there is also an opportunity for us to expand our appreciation of geological thought beyond the conventional focus on the West and toward traditions that have often been suppressed in conventional narratives.

Javanese geology helps us understand how thoroughly contemporary discussions of the Anthropocene are a spiritual project. It is often assumed

that the earth sciences could not be further from theology, that geological narratives are the result of a secularizing society shirking the grasp of its Christian narratives. Java shows us otherwise. It was not only Christianity that was at stake in geological narratives, it was also Islam, Hinduism, Buddhism, and animism. Deep time was contrived in a space crowded with temporalities—catastrophic, circular, rhythmic, spiraling, linear. And it adapted to them, incorporated them, and sometimes sought to repress them. Geological time—and, in particular, Anthropocene time—thus remains religious time, the inheritance of struggles with religious traditions. It is strange to think that geology was ever secular, or that secularism ever succeeded, or that the Anthropocene is a secular science. Instead, Javanese geologists learned from and leaned on Hindu temporal narratives, ancient Greek myths, and Islamic saints and ancestors to build their modern science that shaped the very standard modern earth stories that we have inherited, even the theory of plate tectonics. This book is about these pedagogies, these messy intercalations from paranoid praying mapmakers to scientist mystics with seismographs; it is about how they created “our” modern earth on the slopes of Javanese volcanoes.

LIVING WITH VOLATILE GEOLOGY · I first learned about Javanese geology after turning a corner. I was in a taxi on the way to the airport in Surakarta, a medium-sized city in Central Java. As the taxi driver took a left turn, the road suddenly pointed in the direction of a cone emerging from the land, the summit was jagged, stone gray, half obscured by clouds.

“What is that?” I asked the taxi driver. “That? Oh, that is Merapi.”

I soon learned that Merapi was a volcano, that it was active, and inhabited. Some people were saying that nearly one million people lived there. I also learned that a few years earlier, in 2010, it had erupted and killed a so-called gatekeeper who lived in a village close to the caldera. I read in the *Guardian* that there was a conflict between scientists and the gatekeeper because he had refused to leave the volcano during the eruption. The article referred to him as the volcano’s “spiritual guardian.”

My intuition told me that the people who lived on Merapi had things to teach those of us who did not live there. My hunch was that the extreme and unpredictable environment on Merapi was the future many of us are headed for as the climate crisis produces ever more uncertainty in natural systems. Merapi, too, is all about unpredictability, and people have been

living with it for centuries. It seemed to me that this was what people there could share wisdom about.

On my first trip up the flanks to the village of Deles, I met a man named Sukiman. He had an anarchist ethos and celebrated the volcano, with its caldera smoking only a few kilometers away. He embraced an ecological ethic of mutual aid between people, nonhumans, and the volcano. We discussed how he was caring for persecuted monkey communities that lived on the flanks of the volcano and provided early warning signals for eruptions when they fled before humans even sensed danger. He also advocated pesticide-free farming and planting native crops. Sukiman was well known in the region as an outspoken critic of government and as an advocate for disaster management reform. He even presented his case to the United Nations.

I came to understand that villagers in Deles, with Sukiman's encouragement, were self-managing their own disaster risk reduction and preparedness. They took advantage of their proximity to the caldera to take videos and photos of eruptions and later sell them to international media outlets, keeping the proceeds in a collective community pot dedicated for disaster relief. Communal savings were also created from voluntary contributions from villagers' harvests. Evacuations, Sukiman told me, were pitched as holidays, periods of reprieve from the boredom of everyday labor. The villagers were trying to build a communitarian ethos of mutual aid to manage the uncertainty of the volcano. Rather than fear the volcano, they shared an ecology, a cosmology even, of mutualism. This seemed promising—inspiring actually. Perhaps we, too, could learn how to thrive with the radical uncertainty of nature, even in its most extreme circumstances. Perhaps we could transform uncertainty into a vehicle for creating deeper forms of interdependence between society and nature. Maybe that is what residents on Merapi could teach us.

On that same trip, I also visited the village of Kinaredjo, where Maridjan, the “spiritual guardian” from the *Guardian* article, had died in the eruption of 2010. The destroyed parts of the village had been rebuilt, including a new mosque in the traditional wooden Javanese style. I met Maridjan's son, Asih, who had taken over the job from his father and who explained to me that he was continuing his father's work of undertaking annual pilgrimages to the volcano to give it offerings. In the village, a disaster tourism business had sprung up, taking curious passengers on Jeep rides to the hard, dusty, dried lava flows nearby. Kiosks were selling Kinaredjo tea, souvenirs, and T-shirts with Maridjan's face emblazoned

on them. I was told that the Jeep business was so lucrative that some of the drivers had made enough money to open their own restaurants. The eruption had been devastating, but it also provided new economic opportunities and chances for regrowth.

It was on this visit that I learned of the richness of the stories about the volcano, the expansive pantheon of gods and goddesses and ghosts that live inside it and on its flanks. Keeping these stories alive and meaningful was crucial to Maridjan's and Asih's work as well as to devoted followers in the village and across Indonesia. Many Javanese men saw that Maridjan, before he died, upheld a tradition of so-called local wisdom, a quintessentially Javanese form of mysticism in which volcanic activity was inseparable from social and political orders and volcanic tremors and explosions signaled not just nature but also a society in duress.

Later, I began to spend time on leafy Cendana Street in north Yogyakarta, in the government volcano observatory. The observatory had its origins and mandate in the early twentieth century, when Indonesia was a Dutch colony, to monitor the volcano and warn the population of eruptions. Today, it is a high-tech, well-respected scientific volcano observatory. As scientists monitor the volcano from Cendana Street, there are also six outposts on the slopes and dozens of smaller, unmanned, transmitting stations. In the main observatory, there are nearly one hundred staffers. Some of them are on twelve-hour rotations, reading seismographs and overseeing television monitors. Tilt meters measure the deformations of the ground, and an assortment of other instruments surveil and record the volcano's every move and breath. During the eruption in 2010, observations went all the way from the slope of Merapi to Yogyakarta, Bandung, the presidential palace in Bogor, and the United States Geological Survey (USGS).

There were not only farmers constructing multispecies mutual-aid communities but also Javanese mystics, enterprising disaster victims, and scientists, each trying to make sense of the unpredictability of Merapi. Each of these groups often had very different stories to tell about the volcano. Scientists understood that it was part of the global plate tectonic system. South of Java, they reasoned, about five hundred kilometers away in the Indian Ocean, was a continental subduction zone, where the Australian plate was driving below Java and resurfacing on land through volcanic outbursts. They not only thought Merapi was the result of planetary evolution; they were also representatives of the state and public health officials dedicated to protecting the population. Yet, in Kinaredjo,

where Maridjan died, many villagers celebrated narratives that had been transmitted from before the colonial era and the establishment of any scientific observatory. For many residents on the upper slopes, volcanic activity was made sense of through references to stories connected to the founding of the sultanate in Yogyakarta in the eighteenth century; these stories suggested that the first sultan to rise to power and establish a kingdom in the sixteenth century had done so through arrangements (marriage and treaties) with deities in the volcano and the Indian Ocean. Living with the volcano demanded offerings and rituals because volcanic activity was connected to human moral and ethical behavior. What animated nature, according to stories in the observatory and in the villages, were different, seemingly exclusive, and contradictory forces. Sometimes those incompatible visions were held together in a fragile assemblage, sometimes by one person. I met Indonesian scientists who prayed to Allah in the observatory between meetings about the most recent seismograph readings. I met a white French seismologist who spoke excellent Javanese and fluent Indonesian, and who joined Javanese rituals with his Javanese partner. I met scientists who held that the theory of plate tectonics confirmed the origin stories of the Central Javanese sultanates. I drank tea with Javanese mystics trained as seismologists and with seismologists who meditated on the meaning of nothingness. One afternoon, I had a conversation with an observatory technician who had seen ghosts wandering around the observatory the night before. It is no surprise that people hold seemingly contradictory and inconsistent views, nor is it world-shattering to encounter it in Indonesia. It has long been a prevailing interpretation by Western and Indonesian intellectuals that Indonesian culture emerges from a long history of stitching together diverse cosmologies from centuries of cosmopolitan contact.

I began to split my time between the observatory and the village of Keningar on the western slope, a village high up the slope, similar to Deles. Keningar is subject to intense, widespread, and mainly illegal sand mining, where local and Indonesian migrant laborers dig at the residue of past eruptions, deposits of sand, ash, and stones. The mining was causing profound ecological destruction to the river valleys, agricultural land, and the water supply. It also gave rise to social conflicts and sometimes violence between environmentalists, farmers, and miners. Village activists responded with litigation and pushed hard and ambitiously on what they saw as a stressed and dysfunctional legal system. On top of that, they were

also practicing spiritual activism, performing rituals, mysticism, magic, and spirit possession to fight corruption and drive the miners away.

Volcano scientists had a difficult time gaining respect in these circumstances. Many people in Keningar were suspicious of government officials, including scientists, suspecting that they represented, or were directly implicated in, government corruption—the same government that also failed to protect their rivers and landscapes from mining. Some scientists saw the “traditional practices” of ritual, magic, and spirit possession in Keningar as forms of folk culture, which they dismissed as voodoo and peasant superstition. At the worst of times, scientists, mystics, and activists were locked in holding patterns of mutual misrecognition.

I met a farmer in Keningar, Sukidi, a man in his eighties, who mediated local spirits. The spirits, he told me, were enraged by the mining, and if it continued there was sure to be an eruption, or at least a landslide. The volcano was talking back to the miners; it was in solidarity with activists and farmers. Sukidi told me that his friends often encountered volcano spirits in their dreams; when people died, their spirits went into the volcano. The mountain was social history materialized. Eruptions and landslides, the shuddering of volcanic earthquakes, were the gestures of rage-filled intercessions. Merapi had much to say; it was a matter of learning how to hear it.

This was what interested me in Keningar—Sukidi and his friends could help us live in the Anthropocene, an age of volatile and unpredictable nature constitutive of human agency, a period in which geology is woven with human culture, not only imprinted and inscribed by human efforts—cities, roads, and mines—but also haunted to its core in the very categories that describe geology and the sciences that study it. Anthropocene geology is also on the move, destabilizing the conventional boundaries between culture and lithos in an unceasing geological undermining. The animate geology of Keningar seemed to offer a new way into thinking the present more broadly by resolutely denying the conventional distinctions between stones and persons, human sociality and lithic substrate, politics and geology, and replacing them with a form of geological thought that is also always social thought, in other words, a political geology.

Making sense of the uncertainty of the volcano was inseparable from navigating ways of knowing, which in turn meant navigating multiple, sometimes competing, practices of mediation. Merapi was multiple indeed. Yet its fragments were bound together. What was certain was the

common magic of conjuring the hidden interior of the volcano and earth. As Bernard Siegart has argued, the often-assumed distinction between high-tech and folk-tech is condescending; they both, in their different ways, share the magic of conjuring invisible worlds.¹ The technologies of modern Javanese volcanology and mysticism conjure from felt tremors the constant churning of a plate tectonic earth renewing itself and the voices of restless spirits. What the magic of volcano science makes clear is just how flawed our contemporary narratives are about the disillusionment and disenchantment of the modern sciences. The earth sciences, in fact, have their ontological feet, as it were, in the magical act of conjuring hidden worlds such as the processes buried deep inside volcanic mountains or their gurgling magma chambers. And a volcano observatory is an utterly enchanted space, replete with idols (photos of volcanoes), daily rituals (reading seismographs or tilt meters), and an acknowledgment among volcanologists that they are witnesses to the utter mysteriousness of the earth's processes. Such acknowledgment runs counter to traditions of critical social theory that berate the sciences for banishing mystery from the world through rationalization, alienation, and instrumentalization. Contemporary attempts to revive the mysteries of geology through poetically inflected reflections on nature or poetic experiments with social theory often reproduce this misunderstanding: volcanology, and specifically volcanology in Java, has never been disenchanting; it has always been in magic-making collusion with mystical Islam, geological animism, socialized geology, possession play, ancestral obsessions, and other techniques of living with and through invisible worlds. This book is about these uneven, shifting boundaries, piggybacking, and unexpected collaborations. When we try to imagine how to live in a new geological epoch in which lithic and human processes seem uniquely conjoined, we are actually inheriting a much older conception of the earth. The rest of this book shows how that conception came to be and what it can tell us about living with the earth.

PLAN OF THE BOOK · Chapter 1 outlines the core ambition of political geology, which is to explore the intersections of politics, the geological sciences, cosmology, and culture. Political geology was inspired in part by discussions surrounding the Anthropocene and a turn across the humanities to grappling with geological agency. Yet, as the chapter shows, political geology, with its attention on the history of geological and earth

knowledges, reveals how the Anthropocene debate in the geosciences was prefigured by Javanese spiritual geographies and volcanology for at least a century. The Anthropocene debate, in fact, belongs to the much older ambition in the geological sciences to question the boundaries between society and the earth, between *bios* and *geos*. The Anthropocene debate also signals a moment in which modern scientists are implicitly engaging much older ideas that have long been central to Javanese political philosophy, including the notion that politics is foundationally geological. The chapter then explores three significant volcanic eruptions and the colonial-political milieu that brought about the formation of volcanology as a modern science of governance in Indonesia.

Chapter 2 examines four geological maps of Java and the contexts of their production to explore how geological narratives of Java have changed since the late nineteenth century. The chapter traces how these maps represented Javanese volcanism and were tied to shifting scientific narratives of the earth's history. The chapter shows that geologists transformed their vision of Java as an island of natural and cultural antiquities in which volcanoes were the ruins of once great mountains, to a vision of Java as a young island in the violent throes of youthful earth-building. Adopting and adapting ideas of continental drift before many other geologists around the world did were key to this transformation. Combining oceanography with terrestrial geology was crucial to this new view, which later set the stage for the development of the theory of plate tectonics in the 1970s. The maps examined in this chapter were turning points in this new earth history.

Chapter 3 shows how the theory of plate tectonics landed on Mount Merapi. The chapter explores how the contemporary theory of the relationship between ocean and land was prefigured and enabled by Javanese spiritual geographies. The Central Javanese sultanates emerged through an acknowledgment that deities in the ocean and volcanoes were related to the sultans. Political power was made possible through these associations with chthonic deities. The theory of plate tectonics mirrored this belief structure. It was based on a radical shift in geological thought to understanding the exchanges between oceans and volcanoes as related. This chapter explores how these two visions fit together and the politics of their clashing and melding. It follows both the mystics and sultans as they gave offerings to volcano and ocean deities and the geologists as they, in turn, considered the mystical foundations of plate tectonics. The chapter describes these intersections in terms of *intercalation*.

Chapter 4 turns to the beginning of volcanology in the Netherlands East Indies and the anxieties of late colonialism. It traces the fate of the idea that medieval Javanese Hindu-Buddhist civilization was destroyed by a cataclysmic eruption of Merapi in AD 1006. This idea became a way to naturalize the end of a culture and to explain the rise of Islam. Colonial scientists in the twilight years of their own empire explored imaginaries of radical environmental change and cultural impermanence. Theosophists, Javanese nationalists, aristocrats, Sanskritists, philologists, and volcano scientists trudged up and down the slopes of Merapi looking for mystical communion with the earth.

Chapter 5 traces the origins of geopoetics in the work of the largely forgotten geologist Johannes Umbgrove in Java in the 1920s. The chapter shows how Umbgrove developed an aesthetic conception of geologizing that became an expansive notion of cosmic and terrestrial evolution. In his book *The Pulse of the Earth*, published in 1942, Umbgrove developed *geopoetics* as a means to describe his scientific method that connected the psyche to the galaxy. The earth, mind, and cosmos were understood as structured by polyphonic rhythms and cycles; geopoetics had nothing to do with poetry about rocks. This chapter explores how Umbgrove developed geopoetics not only on Javanese volcanoes but also in conversation with orientalist such as Paul Deussen, a friend of Nietzsche's and translator of the *Upanishads*. Umbgrove's influence went on to shape the early formulations of the theory of sea-floor spreading and plate tectonics in the 1960s. When Umbgrove's geopoetics became plate tectonics, it sought to create a vision of the earth as a system of creative destruction.

Chapter 6 considers the significance of volcano observatories as contact zones between volcanology, geopolitics, and the Javanese ethnonationalist mystical movement Kejawen (Javanism). The chapter explores the development and evolution of one observatory on Merapi that acted as a place where new technologies contributed to shifting conceptions of the human body, the earth, and communication. The chapter also examines how observatories were places through which the Indonesian, French, and other states could operate at rural frontiers to manage political crises. Kejawen had its roots in the late colonial spiritual geographies of Central Java, theosophy, and mystical Islam; and observatories became sites at which Kejawen practitioners struggled with imaginaries of the Republic, infrastructure, and volcanism. As much as observatories were architectures of the state, they were also places where scientists' and mystics' ideas about spatial and temporal proximity transformed each other.

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THIS PROJECT HAS MOVED AROUND A LOT · I have carried it, and it, in turn, has carried me. Parts of it were written in notebooks in Singapore, in a room in Jakarta, at a temporary desk with piles of old photobooks in the volcano observatory in Jogja, with final read-throughs in Central Sulawesi. There was the pleasant library with the quiet transistor radio at the Geological Survey in Bandung, and there were the rainy days on the deck by the cashew grove in Lombok. Many hours were spent in a *gubuk* on the edge of Mount Merapi getting away from the project, listening to the forest, and hanging out with Giyono. Cambridge, Sydney, Jogja, Malang, Surakarta, Kuala Lumpur, Hong Kong, London, Amsterdam, Tasmania, Glasgow, and the South Downs were some other places where bits and pieces or entire chapters were written, jettisoned, and rewritten. And on volcanoes, most often Merapi, but also Tangkuban Perahu, Idjen, Kelud, Merbabu, Rinjani, Vesuvius. All these topographies nourished this book and deserve thanks.

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Earlier versions of some of the arguments in this book have appeared in different forms in the following: “Processions: How the Spiritual Geographies of Central Java Shaped Modern Volcano Science,” *Indonesia* 113 (April 2022): 51–66; “A Javanese Anthropocene?,” *HKW Anthropocene Curriculum*, April 22, 2022, <https://www.anthropocene-curriculum.org/contribution/a-javanese-anthropocene>; and “The Spiritual Geographies of Plate Tectonics: Javanese Islam, Volcanology, and Earth’s New History,” *New Earth Histories*, ed. Alison Bashford, Emily Kern, and Adam Bobbette (Chicago: University of Chicago Press, 2023).

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Unless otherwise noted, all translations are my own.

CHAPTER ONE

POLITICAL GEOLOGY AS METHOD

POLITICAL GEOLOGY · Political geology was created to bring together geology and politics in new ways. It developed largely within a milieu of geographers and was, in part, inspired by discussions surrounding the Anthropocene.¹ But political geology also resonated with conversations across the humanities with shared interests in the social life of geology and the geology of social life. Political geology attempted to extend those interests by foregrounding the *geos* in the geopolitical at the very moment when many contemporary geopolitical analyses had forgotten that the *geos* of politics was actual material: grounded geological processes.² Turning to a concerted analysis of the ways that the earth and geological matter became politicized dovetailed with emerging critical analyses of extractivism and modern state politics, which showed that the transformation of nature into a resource was a process that coupled epistemology and technology.³ Political geology could then foreground the ways in which the geological sciences were perhaps some of the most profoundly significant sciences in shaping the modern world because they provided the knowledge that drove extractivism. There would be no carbon capitalism, in other words, if not for the geological sciences. It would therefore be a mistake to try to give an account of the history of that earth-transforming capitalism without explaining how the sciences

helped to define, prospect, and extract minerals, ores, and fuels. The political geology that is explained in this book, therefore, provides an expansive account of extractivism by explaining the social production of deep geological time, its context and controversies, and how it has been wrapped up with theology and cosmology. Extractivism, it might be said, is a cosmology. Providing such an account means acknowledging that the geological sciences were tools of European empire.

Yet, less obviously, those tools were also shaped or transformed by world knowledge traditions. This fact is rarely sufficiently acknowledged in critical literature on extractivism or the Anthropocene, where diffusionist models of scientific knowledge (“from the West to the Rest”) are commonplace. The geological sciences are, in reality, cosmopolitan not only in the sense that they were developed by scientists acting in many parts of the world but also in the sense that there were (and continue to be) global traditions of geological knowledge independent of European or North American science. Moreover, those traditions helped author the standard European geological sciences. Modern geology, then, including the extractive sciences, is the product of global intelligence: encounters, brokering, and negotiation shaped them, not a linear dissemination.⁴ While histories of the geological sciences have been amply told from the perspective of European and US scientists, it is less well understood how they were authored by actors conventionally understood as marginal, or peripheral, and then fed back to transform metropolitan ways of thinking. A multicentered vision of the movement of geological knowledge, with attention to the encounters, brokering, thefts, and gifts that produced it, can help complicate narratives that try to find redemption in local or indigenous counter-knowledges as resistance to extractivist modernity. Instead, the political geology in this book demonstrates just how long and winding the paths have been for many commonplace geological concepts; in fact, much global geological knowledge is local knowledge made planetary. The same ways of thinking about geology that Dutch colonial geologists encountered in Indonesia in the early twentieth century, for instance, then went on to create new Western scientific narratives about the entire earth. They were, in fact, even redeployed in new theoretical contexts to form the basis for the theory of plate tectonics while the local origins of the theory (and Indonesian intellectuals) were written out of the story. Part of the method of political geology is tracing these erasures, shifts of scale, and unexpected influences of geological knowledge

to follow their transmission and how they end up enabling extractivist practices.

Much of the geology in this book is on the move and in the making. Unlike many other extractivist contexts in which the sciences stabilize and fix geology in place—turning it into a resource through quantification, spatialization, and mapping—volcanoes are completely different. They explode and melt and rumble. They cannot be approached or hacked away at like a gold or nickel deposit. Therefore, volcanic political geology is a different kind of politics and a different kind of geological knowledge. The core relationship to volcanoes in colonial Indonesia, as we will see, was not a form of extraction through stabilization—it was not about mining underground or scraping the surface—instead, it was about the management of volatile, unpredictable matter in space and time, of negotiating flows and rhythms and pulses to protect an extractive plantation economy. The thrust of geological knowledge about volcanism was not how to identify profitable ores, minerals, and fuels but, instead, how to anticipate a disaster, identify cycles and patterns of eruptions, and predict the future to protect plantation labor and better organize plantation land. Geologists thought about geology not as stable and fixed objects, nor according to the long and slowly transforming processes of geological evolution, but as a material that flows. Their goal was not to take geological material and transform it into a commodity but to negotiate its ability to suddenly move and destroy an already immensely profitable plantation economy; it was a political geology of choreography. They sought to bring society together with a mobile nature.

This eruptive political geology was often troubled by the porosity of the *geos* and *bios*. As Kathryn Yusoff and Elizabeth Povinelli have shown in their analyses of extractivist capitalism, the very categories—*geos* and *bios*, geology and biology, the living and the dead—are the product of a fundamentally cultural, political, and historical process. The geological sciences played a key role in shaping that distinction.⁵ The drawing of the dividing line between *geos* and *bios* was not only a product of modern scientific categorization; it was also a profound political maneuver. By separating *biological life* from *dead matter*, things could be ordered into new hierarchies: mere *matter* could become extractable, exploitable, and fungible, while what was endowed with *life*, the organic, could be placed above and endowed with uniquely respectable values. The solidification of these categories lent ballast to imagined hierarchies between humans

and geological material; there could be no human exceptionalism without the privileging of the *bios* over the *geos*. (Some) humans were seen as uniquely different from and above the lowly matter of inorganic (dead) geological material. However, the political geology of Javanese volcanology since the late nineteenth century tells a more complicated story. The relationship between *bios* and *geos* in Java has consistently been seen as horizontal, porous, and fundamentally destabilizing. One reason for this was the relentless vibrancy of volcanoes; they seemed to express the liveliness of the earth itself. It was difficult for scientists and earth theorists on volcanoes to neatly parse out and privilege biological matter from dead, inorganic material. Were the volcanoes not alive? How could you not acknowledge the vibrant agency of a liquefying mountain? Indeed, even the geologist Johannes Umbgrove came to understand in the 1930s that the line between the *geos* and *bios* was porous, always on the move, and fundamentally elusive. He saw, too, that this realization was consistent with the cosmology outlined in the *Upanishads*, which in turn shaped the knowledge systems of the early Javanese kingdoms built on the volcanic plains where he had come to question the distinction between *geos* and *bios*. Hindu cosmology, Umbgrove thought, already showed that life was geological. The modern sciences, he argued, were only now catching up to that insight. Colonial volcanologists like Umbgrove were therefore ready to imagine a different kind of nature, one not burdened by the hierarchies of extractivism. Umbgrove's work belongs to an undercurrent in the modern geological sciences that has been generally ignored or forgotten by contemporary researchers interested in the Anthropocene and in the history of the geological sciences. Revealing this undercurrent can help complicate our narratives of the history of geology because it foregrounds scientists who were interested not in separating the living from the dead but instead in troubling their distinctions, in operating in the ambiguous spaces between biological and lithic life, where volcanoes could become persons and persons could transform into cold, petrified slabs hanging on the side of crater and known as lava tongues.

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