# Cascadias Fault The Coming Earthquake And Tsunami That Could Devastate North America Jerry Thompson

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The Big One

Sasquatch Books The west coast of North America faces the risk of tsunamis generated by seismic rupture in three regions, namely, the Cascadia subduction zone extending from southwestern British Columbia to northern California, the southern Queen Charlotte margin in the Haida Gwaii area, and the Winona Basin just northeast of Vancouver Island. In this thesis, I construct tsunamigenic rupture models with a 3-D elastic half-space dislocation model for these three regions. The tsunami risk is the highest along the Cascadia coast, and many tsunami source models have been developed and used in the past. In efforts to improve the Cascadia tsunami hazard assessment, I use an updated Cascadia fault geometry to create 9 tsunami source models which include buried, splay-faulting, and trench-breaching rupture. Incorporated in these scenarios is a newly-proposed splay fault based on minor evidence found in seismic reflection images off Vancouver Island. To better understand potential rupture boundaries of the Cascadia megathrust rupture, I also model deformation caused by the 1700 C.E. great Cascadia earthquake that fit updated microfossil-based paleoseismic coastal subsidence estimates. These estimates validate the well-accepted along-strike heterogenic rupture of the 1700 earthquake but suggest greater variations in subsidence along the coast. It is recognized that the Winona Basin area just north of the Cascadia subduction zone may have the potential to host a

tsunamigenic thrust earthquake, but it has not been formally included in tsunami hazard assessments. There is a high degree of uncertainty in the tectonics of the area, the presence of a subduction "megathrust", fault geometry, and rupture boundaries. Assuming worst-case scenarios and considering the uncertainties, I construct a fault geometry using seismic images and generate six tsunami sources with buried and trench-breaching rupture in which downdip rupture extent is varied. The Mw 7.8 2012 Haida Gwaii earthquake and its large tsunami demonstrated the presence of a subduction megathrust and its capacity of hosting tsunamigenic rupture, but little has been done to include future potential thrust earthquakes in the Haida Gwaii region in tsunami hazard assessment. To fill this knowledge gap, I construct a new megathrust geometry using seismic reflection images and receiver-function results and produce nine tsunami sources for Haida Gwaii, which include buried and trench-breaching ruptures. In the strike direction, the scenarios include long ruptures from mid-way between Haida Gwaii and Vancouver Island to mid-way between Haida Gwaii and the southern tip of Alaskan Panhandle, and shorter rupture scenarios north and south of the main rupture of the 2012 earthquake. For all the tsunami source and paleoseismic scenarios, I also calculate stress drop along the fault. Comparison of the stress drop results with those of real megathrust earthquakes worldwide indicates that

these models are mechanically realistic.

Cascadia's Fault Crown Publishing Group (NY)

An investigation of the earthquake potential in the Pacific Northwest and examination of the measures necessary to reduce seismic hazards.

**The Best American Magazine Writing 2016** Voyageur Press

**There is a crack in the earth's crust that runs roughly 31 miles offshore, approximately 683 miles from Northern California up through Vancouver Island off the coast of British Columbia. The Cascadia Subduction Zone has generated massive earthquakes over and over again throughout geologic time—at least thirty – six major events in the last 10,000 years. This fault generates a monster earthquake about every 500 years. And the monster is due to return at any time. It could happen 200 years from now, or it could be tonight. The Cascadia Subduction Zone is virtually identical to the offshore fault that wrecked Sumatra in 2004. It will generate the same earthquake we saw in Sumatra, at magnitude nine or higher, sending crippling shockwaves across a far wider area than any California quake. Slamming into Sacramento, Portland, Seattle, Victoria, and Vancouver, it will send tidal waves to the shores of Australia, New Zealand, and Japan, damaging the economies of the Pacific Rim countries and their trading partners for years to come. In light of recent massive quakes in Haiti, Chile, and Mexico, Cascadia's Fault not only tells the story of this potentially devastating earthquake and the tsunamis it will spawn, it also warns us about an impending crisis almost unprecedented in modern history.**

*Penrose Conference, Great Cascadia Earthquake Tricentennial* Sasquatch Books

By the world-renowned seismologist, a riveting history of natural disasters,

their impact on our culture, and new ways of thinking about the ones to come Earthquakes, floods, tsunamis, hurricanes, volcanoes--they stem from the same forces that give our planet life. Earthquakes give us natural springs; volcanoes produce fertile soil. It is only when these forces exceed our ability to withstand them that they become disasters. Together they have shaped our cities and their architecture; elevated leaders and toppled governments; influenced the way we think, feel, fight, unite, and pray. The history of natural disasters is a history of ourselves. In The Big Ones, leading seismologist Dr. Lucy Jones offers a bracing look at some of the world's greatest natural disasters, whose reverberations we continue to feel today. At Pompeii, Jones explores how a volcanic eruption in the first century AD challenged prevailing views of religion. She examines the California floods of 1862 and the limits of human memory. And she probes more recent events--such as the Indian Ocean tsunami of 2004 and the American hurricanes of 2017--to illustrate the potential for globalization to humanize and heal. With population in hazardous regions growing and temperatures around the world rising, the impacts of natural disasters are greater than ever before. The Big Ones is more than just a work of history or science; it is a call to action. Natural hazards are inevitable; human catastrophes are not. With this energizing and exhaustively researched book, Dr. Jones offers a

look at our past, readying us to face down the Big Ones in our future.

**Saving Cascadia**

Createspace Independent Publishing Platform

Revised edition of: Natural hazards: explanation and integration / Graham A. Tobin and Burrell E. Montz. c1997.

**Full-Rip 9.0**

Cambridge University Press

A few hundred years ago, Cascadia Island didn't even exist. Like the Washington seacoast, it was rock submerged beneath the Pacific. A massive earthquake changed that, exploding the rock upward, making it land -- unstable land, according to seismologist Dr. Doug Lam. Lam has spent years researching the Cascadia Subduction Zone. He published a theory that the unrelieved tectonic strain beneath the idyllic landscape of Cascadia Island could be triggered with modern construction processes -- with catastrophic results. The paper was disregarded, even ridiculed, by his peers and by megawealthy developer Mick Walker,

who stands to earn millions from the construction of a luxury resort on Cascadia. The elegant casino, hotel, and convention center will reap millions for him even if the tiny island only lasts for a short time... When a series of earthquakes begins to shake the Northwest Corridor, Doug's worst fears are confirmed. In an attempt to convince Walker to evacuate Cascadia immediately, Doug hurries to join guests arriving for the resort's grand opening. As the tremors wreak havoc across the Northwest coastal area, the military is left with too few resources to assist the people on Cascadia. Convinced that the island will be in ruins within hours, Doug reluctantly calls upon his girlfriend, Jennifer Lindstrom, president of Nightingale Aviation -- a major medical transport helicopter company -- for help. With snow falling, visibility dropping, and winds increasing,

Doug embarks on an impossible mission with Jennifer and Nightingale's helicopters to evacuate over three hundred people, while smaller earthquakes continue to herald the approach of a catastrophic tsunami. John J. Nance hurtles readers along a nail-biting quest to rescue hundreds of stranded vacationers and resort staff. Meticulously researched, and with the signature authenticity only a veteran pilot could provide, Saving Cascadia is a hair-raising thriller of awesome magnitude. **On Borrowed Time** Rowman & Littlefield An essential guide for anyone interested in understanding earthquake science or in preparing for the next major tremor. **Models of Tsunamigenic Earthquake Rupture Along the West Coast of North America** Anchor The Cascadia Subduction Zone is a crack in the earth’s crust, roughly fifty kilometres offshore, running 1,100 kilometres from northern Vancouver Island to northern California.

About every 500 years this fault generates a monster earthquake. There is roughly a thirty percent chance that it could happen again within the next fifty years. Or it could happen tonight. Without a doubt, the coming quake is one day closer today than it was yesterday. The Cascadia Subduction Zone is virtually identical to the offshore fault that wrecked Sumatra in 2004, and it will generate the same type of earthquake, a magnitude nine or higher. It will send crippling shockwaves across a far wider area than any of the California quakes you've ever heard about, slamming five cities at the same time: Vancouver, Victoria, Seattle, Portland and Sacramento. Cascadia's fault will wreck dozens of smaller towns and coastal villages -- and no one in these places will be able to call their neighbours for help. Written by a journalist who has been following this story for twenty-five years, Cascadia's Fault tells the tale of this devastating future earthquake and the tsunamis it

will spawn. Curbing Catastrophe Princeton University Press Many regions that are prone to experience strong earthquakes and tsunamis are densely populated, such as the coastlines of the Pacific Ocean and some of the Indian Ocean. These regions are subduction zone settings, where one tectonic plate subducts beneath another, which produces a gigantic fault - a megathrust fault. Subduction zone earthquakes largely occur on such megathrust faults. They have cost an incredible number of lives, and future events pose a constant threat to many more. Especially those megathrust earthquakes that nucleate in or propagate to very shallow depths can cause large damage and tsunamis. In general, the seismicity in the shallow portion of subduction zone megathrusts is low, but recent events such as the 2004 Aceh-Andaman earthquake and tsunami offshore North Sumatra have tragically shown the potential of shallow seismicity. Despite extensive

investigations of multiple geoscientific disciplines, the shallow extent of earthquake rupture and slip of subduction zones around the world is still poorly constrained. Reasons for this lie in the challenging nature of such investigations, because the shallow extent of subduction zone earthquakes lies at sea and well below the ocean floor. Limited knowledge of this shallow earthquake extent reduces the chance of meaningful earthquake and tsunami hazard assessment and thus damage mitigation. Because earthquakes are friction phenomena, a large body of work in earthquake research is based on laboratory friction experiments. Early friction experiments have shown that repetitive frictionally unstable stick-slip sliding on artificial faults in the laboratory represents the small-scale equivalent of earthquakes on faults in nature. Friction on a fault evolves with velocity, slip, and time (rate- and state-dependent friction) and thus can lead to unstable sliding.

Unstable sliding includes periods of fault locking and accumulation of elastic energy, with intermittent periods of fault rupture and slip, which releases the stored energy. The depth interval on the megathrust fault that is capable of unstable frictional sliding and thus earthquake nucleation is called the seismogenic zone. Crucial to estimating the extent of the seismogenic zone is knowledge of the variation of the velocity-dependent frictional behavior with depth. Especially the velocity-dependent frictional behavior at plate tectonic rate has shown to be crucial. This information can be derived from laboratory friction experiments and application of so-called rate- and state-friction laws. Ideally, such experiments should be conducted on fault-zone material. However, such material is difficult to obtain and its availability is very limited. Subduction zone input materials, which are the marine sedimentary column on the subducting plate, are

less difficult to recover and hold important information on where a megathrust forms or what intrinsic frictional behavior the fault-forming material has. Measurements on input material are therefore a valuable alternative to measurements on fault zone material. This thesis presents the results of laboratory friction experiments at room temperature, under relatively low pressure, and driven at velocities starting from plate rate. These experiments were designed to investigate the frictional behavior of subduction zone input sediments and its implications on the fault slip behavior and seismic potential of the shallow portions of two subduction zones. The first is the northern Cascadia subduction zone, located along the West coast of North America, where a major earthquake is about to be due. The second is the North Sumatra subduction zone, a region of the Sunda subduction zone and the location of recent destructive earthquakes and tsunamis. At northern Cascadia, the megathrust has so far

not been sampled. Based on measurements of frictional strength contrasts in the input sedimenatry column, we propose that the megathrust fault will likely form in a weak illite-rich hemipelagic clay near the top of the oceanic basement. Because this inference is in good agreement with interpretations of seismic imaging, we focused on the frictional behavior of this specific material. The absence of shallow non-destructive slow slip events at northern Cascadia has recently been interpreted to result from a megathrust that is locked and potentially seismogenic all the way to the trench. In contrast, the results presented in this work indicate that the shallow part of the megathrust is not capable of producing slow slip events nor capable of locking and thus likely not seismogenic. However, our friction data also indicate low resistance to a propagating earthquake nucleating at greater depth. This low resistance is evident from substantially elevated pore pressure, low frictional strength, and low cohesion.

Therefore, the northern Cascadia subduction zone holds the potential of shallow earthquake slip and tsun amigenesis. At North Sumatra, seismic slip during the 2004 Aceh-Andaman subduction zone earthquake was unexpectedly shallow and resulted in a devastating tsunami. Recent work suggested that the cause is a very shallow seismogenic zone that may be created by diagenetic strengthening of fault-forming input sediments prior to subduction. This thesis presents the results of laboratory friction experiments designed to test this hypothesis. We showed that input sediments to the North Sumatra subduction zone exhibit pronounced frictional instability, offering evidence for a frictionally unstable and thus seismogenic shallow megathrust and thus an explanation for shallow earthquake slip in the 2004 event. However, our measurements indicate that the shallow megathrust is not seated in frictionally strong, but in very weak sediments. The combination of weak and unstable sediments is striking because a

large number of previous friction studies have established that weak materials under low temperature and pressure conditions are generally associated with stable frictional sliding. This relationship offers an explanation for the observed general lack of seismicity in the shallow portion of subduction zone megathrusts, where unconsolidated, clay-rich, weak materials are typically encountered. We proposed that threshold amounts of dispersed hydrous amorphous silica in otherwise weak and clay-rich sediments are responsible for an unstable sliding character, which can explain the shallow seismicity at North Sumatra. To test the hypothesis that small amounts of hydrous amorphous silica induce unstable sliding behavior, we designed friction experiments on artificial mixtures of weak shale and biogenic opal, a type of hydrous amorphous silica. These experiments revealed pronounced potentially unstable behavior in mixtures with ? 30 % opal that had low frictional strength.

Based on our results, we proposed that potential unstable sliding at low frictional strength can be explained by the viscous behavior of frictional contacts of hydrous amorphous silica. This highlights the necessity to reevaluate the strength-stability relationship. Our findings support the hypothesis on the role of hydrous amorphous silica in unstable sliding behavior, which has important implications for the potential of shallow seismogenesis at other subduction zones where input sediments contain critical amounts of hydrous amorphous silica. This thesis demonstrates that the northern Cascadia and the North Sumatra subduction zone have very different intrinsic frictional fault slip behavior despite very similar extrinsic properties and attributes, such as temperature or pressure. Thus, intrinsic factors are found to be crucial to the estimation of the slip behavior of shallow megathrust faults, such as a mineral composition of fault

material with threshold amounts of hydrous amorphous silica. Hydrous amorphous silica-bearing sediments could form megathrust faults due to intrinsically low strength and potential of overpressure. The shallow portion of megathrust faults formed in such sediments may thus be able to host large and slow earthquakes. This could for instance be the case in the northern Barbados subduction zone, a setting that similar to the North Sumatra subduction zone has been shown to have a porous, overpressured décollement and predécollement consisting of material that contains elevated amounts of hydrous amorphous silica. Thus, this thesis raises the possibility that subduction zones with a shallow seismogenic zone may be more common than predicted by the seismogenic zone model. This inference implies that earthquake and tsunami hazards could be highly underestimated at some subduction zone settings.

**Curbing Catastrophe**

Springer Science & Business Media

Tide gauges show that

global sea level has risen about 7 inches during the 20th century, and recent satellite data show that the rate of sea-level rise is accelerating. As Earth warms, sea levels are rising mainly because ocean water expands as it warms; and water from melting glaciers and ice sheets is flowing into the ocean. Sea-level rise poses enormous risks to the valuable infrastructure, development, and wetlands that line much of the 1,600 mile shoreline of California, Oregon, and Washington. As those states seek to incorporate projections of sea-level rise into coastal planning, they asked the National Research Council to make independent projections of sea-level rise along their coasts for the years 2030, 2050, and 2100, taking into account regional factors that affect sea level. Sea-Level Rise for the Coasts of California, Oregon, and Washington: Past, Present, and Future explains that sea level along the U.S. west coast is affected by a number of factors. These include: climate patterns such as the El Niño, effects from the melting of modern and ancient ice sheets, and geologic processes, such as plate tectonics. Regional projections for California, Oregon, and Washington show a sharp distinction at Cape Mendocino in northern California. South of that point, sea-

level rise is expected to be very close to global projections. However, projections are lower north of Cape Mendocino because the land is being pushed upward as the ocean plate moves under the continental plate along the Cascadia Subduction Zone. However, an earthquake magnitude 8 or larger, which occurs in the region every few hundred to 1,000 years, would cause the land to drop and sea level to suddenly rise.

Quakeland
National Academies Press
Reprint from Pure and Applied Geophysics (PAGEOPH), Volume 154 (1999), No. 3/4

**Stick-slip**
Frontiers Media SA
There is a crack in the earth's crust that runs roughly 31 miles offshore, ap proximately 683 miles from Northern California up through Vancouver Island off the coast of British Columbia. The Cascadia Subduction Zone has generated massive earthquakes over and over again throughout geologic time—at least thirty–six major events in the last 10,000 years. This fault generates a monster earthquake about every 500 years. And the

monster is due to return at any time. It could happen 200 years from now, or it could be tonight. The Cascadia Subduction Zone is virtually identical to the offshore fault that wrecked Sumatra in 2004. It will generate the same earthquake we saw in Sumatra, at magnitude nine or higher, sending crippling shockwaves across a far wider area than any California quake. Slamming into Sacramento, Portland, Seattle, Victoria, and Vancouver, it will send tidal waves to the shores of Australia, New Zealand, and Japan, damaging the economies of the Pacific Rim countries and their trading partners for years to come. In light of recent massive quakes in Haiti, Chile, and Mexico, Cascadia's Fault not only tells the story of this potentially devastating earthquake and the tsunamis it will spawn, it also warns us about an impending crisis

almost unprecedented in modern history. Cascadia Bell Bridge Books A journey around the United States in search of the truth about the threat of earthquakes leads to spine-tingling discoveries, unnerving experts, and ultimately the kind of preparations that will actually help guide us through disasters. It’s a road trip full of surprises. Earthquakes. You need to worry about them only if you’re in San Francisco, right? Wrong. We have been making enormous changes to subterranean America, and Mother Earth, as always, has been making some of her own. . . . The consequences for our real estate, our civil engineering, and our communities will be huge because they will include earthquakes most of us do not expect and cannot imagine—at least not without reading Quakeland. Kathryn Miles descends into mines in the Northwest, dissects Mississippi levee engineering studies, uncovers the horrific risks of an earthquake in the Northeast, and interviews the seismologists, structual engineers, and emergency

managers around the country who are addressing this ground shaking threat. As Miles relates, the era of human-induced earthquakes began in 1962 in Colorado after millions of gallons of ch emical-weapon waste was pumped underground in the Rockies. More than 1,500 quakes over the following seven years resulted. The Department of Energy plans to dump spent nuclear rods in the same way. Evidence of fracking's seismological impact continues to mount. . . . Humans as well as fault lines built our "quakeland". What will happen when Memphis, home of FedEx's 1. 5-million-pac kages-a-day hub, goes offline as a result of an earthquake along the unstable Reelfoot Fault? FEMA has estimated that a modest 7.0 magnitude quake (twenty of these happen per year around the world) along the Wasatch Fault under Salt Lake City would put a $33 billion dent in our economy. When the Fukushima reactor melted down, tens of thousands were displaced. If New York's Indian Point nuclear power plant blows, ten million people will be displaced. How would

that evacuation even begin? Kathryn Miles' tour of our land is as fascinating and frightening as it is irresistibly compelling. *Earthquake and Volcano Deformation* Catapult The Next Tsunami: Living on a Restless Coast is the gripping story of the geological discoveries--and the scientists who uncovered them--that signal the imminence of a catastrophic tsunami on the Northwest Coast. *Living with Earthquakes in the Pacific Northwest* HarperCollins This book collects 4 keynote and 15 theme lectures presented at the 2nd European Conference on Earthquake Engineering and Seismology (2ECEES), held in Istanbul, Turkey, from August 24 to 29, 2014. The conference was organized by the Turkish Earthquake Foundation - Earthquake Engineering Committee and Prime Ministry, Disaster and Emergency Management Presidency under the auspices of the European Association

for Earthquake Engineering (EAEE) and European Seismological Commission (ESC). The book's nineteen state-of-the-art chapters were written by the most prominent researchers in Europe and address a comprehensive collection of topics on earthquake engineering, as well as interdisciplinary subjects such as engineering seismology and seismic risk assessment and management. Further topics include engineering seismology, geotechnical earthquake engineering, seismic performance of buildings, earthquake-resistant engineering structures, new techniques and technologies , and managing risk in seismic regions. The book also presents the First Professor Inge Lehmann Distinguished Award Lecture given by Prof. Shamita Das in honor of Prof. Dr. Inge Lehmann. The aim of this work is to present the state-of-the art and latest practices in the fields

of earthquake engineering and seismology, with Europe’s most respected researchers addressing recent and ongoing developments while also proposing innovative avenues for future research and development. Given its cutting-edge conten t and broad spectrum of topics, the book offers a unique reference guide for researchers in these fields. Audience: This book is of interest to civil engineers in the fields of geotechnical and structural earthquake engineering; scientists and researchers in the fields of seismology, geology and geophysics. Not only scientists, engineers and students, but also those interested in earthquake hazard assessment and mitigation will find in this book the most recent advances.

**Cascadia's Fault**

Createspace Independent Pub

EPIC Award Winner If you live in the Pacific Northwest, get ready to run for your life . . . In the face of a massive

earthquake and tsunami in the Pacific Northwest, a respected geologist must make two gut-wrenching decisions. One could cost him his reputation, the other, his life. Is the Northwest overdue for a huge quake and tsunami, or will the region remain safe for hundreds of years yet to come? No one knows... or does someone? Dr. Rob Elwood, a geologist whose specialty is earthquakes and tsunamis, is having nightmares of "the big one" that are way too real to disregard. His friend, a counselor and retired reverend, does not think Rob is going nuts. To the contrary, he believes the dreams are premonitions to be taken seriously. No one else does, however, even after a press conference. Some live to regret it, most don't. Rob's drama becomes intertwined with others--a retired fighter pilot trying to make amends to a woman he jilted decades ago and a quixotic retiree searching for legendary buried treasure in the rugged coastal mountains of Oregon. All are about to live Rob's nightmare. "Riveting, scary, and entirely believable . . . a compelling, page-turning thriller with the ring of truth." Jerry Thompson, author of Cascadia's Fault H. W. "Buzz" Bernard, a native Oregonian born in Eugene and raised in Portland, is a best-selling, award-winning novelist. His debut novel,

Eyewall, which one reviewer called a "perfect summer beach read," was released in May 2011 and went on to become a number-one best seller in Amazon's Kindle Store. Before becoming a novelist, Buzz worked at The Weather Channel in Atlanta, Georgia, as a senior meteorologist for thirteen years. Prior to that, he served as a weather officer in the U.S. Air Force for over three decades. He attained the rank of colonel and his "airborne" experiences include a mission with the Air Force Reserve Hurricane Hunters, air drops over the Arctic Ocean and Turkey, and a stint as a weather officer aboard a Tactical Air Command airborne command post (C-135).

**The Seismic Potential of the Shallow Portions of the Northern Cascadia and the North Sumatra Subduction Zones**

Cambridge University Press

"A discussion of major types of natural disasters, including descriptions of some of the most destructive; explanations of these phenomena, what causes them, and where they occur; and information about how to prepare for and survive these forces of nature. Features include an activity,

glossary, list of resources, and index"-- Provided by publisher. Fast to Slow Megathrust Slip and Fault Strength at Seismogenic Depths of the Cascadia Subduction Zone Simon and Schuster "The Cascadia subduction zone is short of modern seism ological records of megathrust earthquakes, which makes it difficult to investigate the potential of fault ruptures directly. At the very beginning of the 21st century, a type of quasi-static fault deformation was observed around the downdip end of seismogenic zones. These aseismic transient events are called slow slip events (SSEs). SSEs accommodate a fraction of the plate convergence and may affect the stress loading at the megathrust depths. The discovery of SSEs sheds light on our knowledge of megathrust faults. This thesis aims to investigate physical constraints for subducting faults at depths of both megathrust

earthquakes and slow slip events. Chapter 1 gives an introduction of the Cascadia megathrust fault and the current understanding of the physics of SSEs.In Chapter 2, I study the physics of the deep SSEs by investigating the effects of the megathrust fault geometry and overlying continental plate. I incorporate a realistic fault geometry of the northern Cascadia in the framework of rate- and state-dependent friction law, to simulate the spatiotemporal evolution of SSEs on a non-planar subduction fault. The modeled SSEs capture the major characteristics revealed by GPS observations. The along-strike distribution of SSE is inversely related to the fault local dip and strike angle of the SSE zone, suggesting a strong geometrical influence. Besides the GPS-detectable fast-spreading phase, I find that each SSE cycle consists of a deep pre-SSE

preparation (nucleation) and a post-SSE relaxation (healing) phase, which may be the driving mechanism for the inter-ETS (Episodic Tremor and Slip) tremor activity that is discovered in Cascadia. In Chapter 3, I develop a 3-D episodic SSE model for the northern and the central Cascadia, incorporating both seismic and geodetic observations to constrain heterogeneous megathrust fault properties. The segmentation of SSE recurrence intervals from models that are constrained by Free-air and Bouguer gravity anomalies is equally comparable to GPS observations. However, the model constrained by Free-air anomaly does a better job in reproducing the cumulative slip as well as more consistent surface displacements with GPS observations. The modeled along-strike segmentation only represents the averaged slip release over many SSE cycles, rather than acting as permanent barriers. In

Chapter 4, I study the fault shear strength at the seismogenic depths by inverting fault strength from tectonic stress tensors in the continental crust and oceanic mantle in Mendocino Triple Junction, the southern end of the Cascadia subduction zone. I obtain the fault strength for the megathrust fault in Mendocino. I use Cascadia Initiative (CI) expedition ocean bottom seismometer (OBS) data to resolve the focal mechanisms for small-to-intermediate earthquakes from 2014 to 2015. The stress orientations are obtained by combining the CI OBS resolved earthquake focal mechanisms with those reported by the Northern California Earthquake Data Center between 1980 and 2016. The fault shear strength scales with a subjective mantle strength assumed in the inversion. When the mantle strength is in the range of 50-400 MPa, the megathrust fault shear

strength can be no higher than 50 MPa. The resolved friction coefficients are in the range of 0 to 0.2. In Chapter 5, I use a planar fault model with rate and state friction parameters constrained by geodetic fault locking coefficients to study megathrust earthquake cycles. The modeled coseismic fault slip can reproduce the historical coastal subsidence observations. The along-strike variation of coseismic rupture is affected by both the width of seismogenic zones and heterogeneous frictional properties (e.g., nucleation size) in Cascadia.Chapter 6 contains conclusions and future scopes." --

Natural Hazards, Second Edition

Columbia University Press

"Physical Geology is a comprehensive introductory text on the physical aspects of geology, including rocks and minerals, plate tectonics, earthquakes, volcanoes, glaciation, groundwater, streams, coasts, mass wasting, climate change, planetary geology and much more. It has a strong emphasis on examples from

western Canada, especially British Columbia, and also includes a chapter devoted to the geological history of western Canada. The book is a collaboration of faculty from Earth Science departments at Universities and Colleges across British Columbia and el sewhere"--BCcam pus website.

The Big Ones

Cambridge University Press

Large-scale earthquake hazards pose major threats to modern society, generating casualties, disrupting socioeconomic activities, and causing enormous economic loss across the world. Events, such as the 2004 Indian Ocean tsunami and the 2011 Tohoku earthquake, highlighted the vulnerability of urban cities to catastrophic earthquakes. Accurate assessment of earthquake-related hazards (both primary and secondary) is essential to mitigate and control disaster risk exposure effectively. To date, various approaches and tools have been developed in different disciplines. However, they are fragmented over a number of research disciplines and underlying assumptions are often inconsistent. Our society and infrastructur e are subjected to

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| multiple types of cascading earthquake hazards; therefore, integrated hazard assessment and risk management strategy is needed for mitigating potential consequences due to multi-hazards. Moreover, uncertainty modeling and its impact on hazard prediction and anticipated consequences are essential parts of probabilistic earthquake | hazard and risk assessment. The Research Topic is focused upon modeling and impact assessment of cascading earthquake hazards, including mainshock ground shaking, aftershock, tsunami, liquefaction, and landslide. |