

Acknowledgments 謝辞



Libraries in Berkeley, Morioka, Seattle, Tanabe, and Tokyo made available, for use in this book, maps that aid in visualizing the bygone world of the orphan tsunami of 1700. The example above—from the collection of the East Asian Library of the University of California, Berkeley—shows moats and samurai neighborhoods spiraling around the castle grounds of Edo in 1684. The white box outlines an area of daimyo mansions (enlarged view, p. 61).



The Berkeley collection can be viewed at <http://www.davidrumsey.com/japan/>. The image above is excerpted from “Eiri Edo ōezu,” published in Ten’na 4 by Hyōshiya Ichirōbe’e. Courtesy of East Asian Library, University of California, Berkeley.

WHERE JAPANESE WRITERS recorded the 1700 tsunami, dozens of people helped us explore questions central to this book: Who wrote the original accounts of the flooding and damage? Why were these accounts written and how were they preserved? Which passages contain errors in copying? Where are the places described as flooded? Were these same places reached by the 1960 tsunami as well?

In Morioka, Konishi Hiroaki granted access to the Morioka-han documents reproduced on pages 36, 38-39, 44-45, 58, and 60. He provided clues on how Morioka-han “Zassho” was compiled, documentation on senior ministers named there, and likely dates for the early 18th-century maps of Miyako-dōri and Ōtsuchi-dōri (p. 36, 44, 58). He serves as librarian of the Documents Office, Morioka City Central Community Center (Kyōdo Shiryō Shitsu, Morioka-shi Chūō Kōminkan).

On the coast in modern Miyako city, Yamazaki Toshio and Sasaki Tsutomu identified places inundated by the 1960 tsunami in Kuwagasaki and Tsugaruishi (photos, p. 49 and 51). In 1999, Mr. Yamazaki was fire chief and Mr. Sasaki one of his deputies at the Central Fire Station of the Miyako Unified Fire District (Miyako-chiku Kōiki Kumiai Gyōsei, Shōbōsho Honbu). Shuto Nobuo of Iwate Prefectural University provided an introduction to Mr. Yamazaki and a walking tour of Kuwagasaki’s tsunami-prone districts. Kishi Shōichi, a historian for Miyako city, shared his knowledge of Miyako’s Edo-period governance. His successor, Kariya Yūichirō, helped us interpret and photograph Moriai-ke “Nikki kakitome chō.”

In Tsugaruishi, Moriai Mitsunori granted access to his family’s notebook, Moriai-ke “Nikki kakitome chō.” He and his mother welcomed three of us into the family home (p. 53). Iwamoto Yoshiteru, an authority on the area’s Edo-period economy (books, p. 116), provided guidance on obscure place names of Tsugaruishi (p. 50, 51, 56).

Morikoshi Ryō of Hachinohe helped Ueda identify copyist’s errors in Moriai-ke “Nikki kakitome chō” by providing a transcription, in printed Japanese, of official records of Hachinohe-han, its “Han nikki” (footnoted, p. 52). Mr. Morikoshi leads Hachinohe Komonjo Benkyō-kai, a group that studies historical documents and which made the transcription of Hachinohe “Han nikki.”

Moriai Mutsuharu, a retired schoolteacher in Tsugaruishi, adopted Atwater and Yamaguchi for a day of

interviewing his fellow villagers about the 1960 tsunami (sites marked by blue and yellow dots, p. 56). Those who identified inundation limits include Yonezawa Takuji (in color photo, p. 57, upper right) and Moriai Miya (photo, below).

In Ōtsuchi, Maeda Zenji, Fujimoto Toshiaki, and Kamata Seizō provided guidance on Edo-period neighborhoods. They also shared the town’s collection of photographs and maps showing sites inundated by the 1960 tsunami. When interviewed in 1999, Mr. Maeda headed Ōtsuchi’s Historical Preservation Council (Ōtsuchi-chō Bunkazai Hogo Shingikai), while Messrs. Fujimoto and Kamata served as assistant director and archaeologist, respectively, in the town’s office of continuing education (Ōtsuchi-chō Kyōiku I’inkai, Shakai Kyōikuka).

Ogawa Kaori journeyed to Ōfunato to learn about that city’s devastation by the 1960 tsunami and its lack of writings on the 1700 tsunami (p. 81). She also checked for written records in Sendai. In Ōfunato she received help from Satō Etsuro of Ōfunato city, Shirato Yutaka and Kin’no Ryōichi of Ōfunato Museum, and Honda Fumito of nearby Rikuzentakada city.

Town officials, local historians, and private citizens of Hitachinaka (formerly Nakaminato) twice received visitors interested in tsunami evidence from Ōuchi-ke “Go-yōdome.” The hosts included Kawasaki Osamu, Onizawa Yōichi, Onizawa Yasuhiko, Saitō Arata, Satō Tsugio, and, from the family that conserves the document, Ōuchi Yoshikuni. Town officials permitted photographs of the volume and of a picture map (p. 66-70).

In Miho, Endō Kunio kindly met with three North Americans to share with them “Miho yōji oboe” and how he came to possess it (p. 76). Mr. Endō’s daughter, Mayumi, arranged a later gathering with two local historians, Endō Shōji and Watanabe Yasuhiro. She also provided copies of books on “Oboe” by Endō Shōji and others (p. 115).

Nagao Toshiyasu of Tokai University joined two of us in Miho for interviews of witnesses to the 1960 tsunami and 1974 storm: Shiba Tsune, Mizuno Teruko, and a lady in the Ishino family (p. 82-83). Moriguchi Osamu, of the central fire office of Shimizu city, arranged for an interview with another witness to the 1960 tsunami, Aoki Yukio.

Officials and residents of Tanabe welcomed us repeatedly for visits that included informative discussions with Kishi Akinori, a local historian, and field trips guided by



Shuto Nobuo at a memorial stone for the 1960 Chile tsunami near Miyako (map, p. 49). The inscription warns that even without an earthquake, a change in water level can mean a tsunami.



Moriai Miya of Tsugaruishi fields questions about flooding of her home by the 1960 Chile tsunami (p. 57, footnote). **Moriai Mutsuharu**, her neighbor, stands at right.

members of the city's general affairs office: its directors, Yamasaki Kiyohiro and Okamoto Yoshihiko, and staffers Urabe Shunji and Shin'ya Jun. Ōta Yūji, librarian with the municipal library, granted access to Tadokoro documents and shared his views of their history (p. 84-87). Hashimoto Kuniko and Minakata Fumie provided a tour of a Tanabe storehouse (photo, below left). In Shinjō, Matsuzaki Tomiji welcomed visitors to a storehouse site (p. 88) and Kashiwagi Tomio provided photos of the 1960 tsunami (p. 89).

Not far from Tanabe, in Hirogawa, Shimizu Isao gave three North Americans an enthusiastic, full-day field trip on Hamaguchi Goryō and his response to the 1854 tsunami that devastated Hiro-mura (photo, below right). At the time of that field trip, Mr. Shimizu was continuing education specialist at the town's community center, Hirogawa-chō Chūō Kōminkan. Tsumura Kenshiro, formerly of Hirogawa, further advised us on Goryō and "Inamura no hi." The picture on page 47 was taken by him and is reproduced with permission of the painting's owner, Yōgen Temple.

IN FORMER EDO, Watanabe Tokie of the Earthquake Research Institute (ERI), University of Tokyo, set up some of the rural visits. Murakami Yoshikane, while a graduate student at ERI, provided a speedy drive to northeast Japan. Katō Teruyuki of ERI advised us on tide-gauge data. Hirata Sakura and Kikuchi Ryōichi of Meiji University allowed us to examine maps of Japan and Suruga province from 1702 (p. 32, 76). Ota Yoko, formerly of Yokohama National University, helped us interpret the picture maps of Moriokahan (p. 36, 44, 58), the inland waterways between Nakaminato and Edo (p. 67), and land-level changes in northeast Japan (p. 65). She also arranged for an Edo mansion for Atwater and his family; and Joel Muraoka provided Tokyo lodging for Yamaguchi.

In nearby Tsukuba, Okada Masami and Tanioka Yūichirō of the Meteorological Research Institute, Japan Meteorological Agency, checked tidal measurements and datums. Odagiri Satoko, of the Geographical Survey Institute, provided old topographic maps. Staff of the Active Fault Research Center, a part of the National Institute of Advanced Industrial Science and Technology, extended countless courtesies to Atwater. These included telephone interviews and trip planning by Isoda Hisako, guidance on Japanese history and language from Horikawa Haruo and



Hashimoto Kuniko leafs through a book from the collection of Minakata Kumagusu (1867-1941), a mycologist and folklorist. She stands in a traditional Tanabe storehouse on a floor 0.4-0.5 m above the ground. The 1700 tsunami may have flooded such a raised floor (B, p. 88).

Nanayama Futoshi, and bibliographic work by Satō Nobue. Dr. Horikawa photographed the monument on page 45; Ms. Satō, the anthologies on pages 62 and 123. Azuma Takashi led the visits to Hitachinaka and to the shogunal maps at Meiji University (p. 32, 76).

Atwater's contributions to the book were made possible, in part, by several visits to Japan. During the longest of these, for nearly a year, his travel and living expenses were covered by Japanese government fellowships from the Center for Global Partnership, ERI, the Science and Technology Agency, and the Geological Survey of Japan. Persons who made these fellowships possible include Usui Akira and Ozaki Hiromi of the Geological Survey of Japan; Satō Hiroshi, Shimazaki Kunihiko, and Murakami Tomoko of ERI; and Ruth Reid and Rebecca Barnhart, and Jack Medlin of the U.S. Geological Survey (USGS).

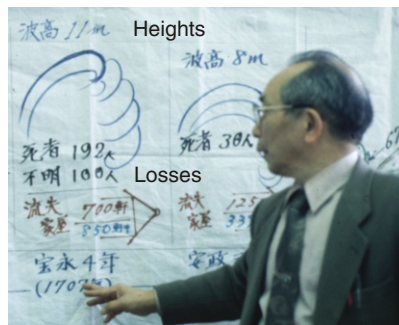
Matsuda Izumi welcomed Atwater to her first-year Japanese language course at the University of Washington. Yamaguchi drew on Japanese language training that includes a summer program in 1976 (sponsored by Sumitomo Bank) and immersion during an appointment at the Hokkaido Research Center of the Forestry and Forest Products Research Institute from 1994 to 1996 (supported by Japan's Science and Technology Agency).

THE NORTH AMERICAN PARENT for Japan's orphan tsunami of 1700 became known through the work of a great many people. The principals include Hiroo Kanamori of the California Institute of Technology; Tom Heaton and Alan Nelson of the USGS; and Minze Stuiver of the University of Washington.

The Nuclear Regulatory Commission underwrote the radiocarbon dating of trees and herbs killed by tidal submergence from the 1700 earthquake (p. 24-25). In Minze Stuiver's lab, Philip Wilkinson analyzed the spruce samples.

Unsung heroes of the earthquake's tree-ring dating include Boyd Benson, Lori Davis, John Shulene, Karl Wegmann, and Marco Cisternas, all of whom helped dig out and sample the stumps of earthquake-killed red cedar.

Pierre Saint-Amand provided sharp prints of the Chilean photos on pages 10 and 11. The Alaskan airphoto on page 14 comes from the collection of A. Thomas Ovenshine and Susan Bartsch-Winkler, formerly of the USGS. Ian Shennan supplied one of the more recent Alaskan images on page 95.



Shimizu Isao of Hirogawa enumerates losses of life and property from the 1707 and 1854 tsunamis in Hiro village (p. 47).

THIS BOOK began in 1999 as a manuscript too large for its initially intended outlet, a volume of papers on subduction zones. Andō Masataka—who twenty years earlier published a seminal paper on Cascadia’s great-earthquake potential—released Atwater from a promise to contribute to that volume.

Critical review began that year with Andrew Moore, then at Tohoku University, and Ruth Ludwin, University of Washington. Ebara Masaharu of the Historiographical Institute, University of Tokyo, corrected subsequent transliterations and translations of the Edo-period documents.

Later drafts were reviewed in full by Emile Okal of Northwestern University; Ruth Pelz of the Burke Museum, Seattle; Yoko Ota; and Ruth Kirk, Kip Ault, Eric Blackford, and an anonymous reader on behalf of University of Washington Press. Suggestions from the anonymous reader spurred reorganization of the book and expansion of its chapters on the Cascadia subduction zone. Additional reviewer were provided by Patricia Atwater, Lori Dengler, Adriana Erickson, Ned Field, Harumi Kato, Hayakawa Yukio, Hal Mojfeld, Joel Muraoka, Yoshiko Sorensen, and Vasily Titov. Pauline Curiel and Satō Nobue printed and circulated the reviewers’ copies.

The book’s cover was developed at University of Washington Press with design by Ashley Saleeba and editing by Alice Herzog and Marilyn Trueblood. Sophia Smith and Pat Soden contributed to the book’s English title.

The reference list includes titles located by Keiko Yokota-Carter, the Japanese-language specialist at the East Asia Library, University of Washington. Inoue Megumi, Nakamura Noriyuki, and Ekida Fusae, bilingual graduate students from Japan, translated reference materials and romanized bibliographic citations. Additional translations were provided by Tajima Maiko and Harada Shino. Annaliese Eipert helped compile the references.

The book’s design is based on a USGS pamphlet by Peter Ward, Robert Page, Laurie Hodgen, and Jeff Troll, and on examples presented by Edward Tufte. Susan Mayfield and Sara Boore of the USGS provided guidance on color, fonts,

and layout; Boore also prepared the block diagrams adapted on page 10. Ed Mulligan and Lorien Freeman, University of Washington, helped us mock up pages by providing computer-network connections and maintaining a color printer.

The USGS granted Atwater freedom to devote several years to the book. Michael Blanpied, Nancy Rountree, Peter Stauffer, and Jane Ciener helped set aside USGS funds for editing and printing. Ruth Kirk initiated discussions, with Michael Duckworth and Pat Soden, that led to joint publication by University of Washington Press.

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- Meiji University Library, Tokyo—p. 32-33, 76
- Morioka City Central Community Center, Documents Office—p. 36, 44, 45, 49, 50, 58
- Ōfunato city—p. 81, 133
- Sendai Museum—p. 127
- Shinjō Community Center—p. 85, 89
- Tanabe Municipal Library—p. 84, 90
- United States National Archives and Records Administration—p. 12
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- University of California, Berkeley, National Information Service for Earthquake Engineering—p. 9
- University of Washington Libraries, Special Collections—frontispiece and p. 2, 13, 104, 129
- Yōgen temple, Hirogawa—p. 47

The paper by Andō Masataka, with Emery Balazs, initiated the study of cyclic land-level change at Cascadia (Ando and Balazs, 1979). We consulted Ward and others (1989) and Tufte (1990, 2001) on book design.



The Nuclear Regulatory Commission, reviewing the design of this power plant, supported carbon-14 dating of Cascadia earthquakes (p. 25).

Satsop, Washington (location map, p. 96).



Boyd Benson, in an Oregon tidal swamp, checks the annual rings of a spruce survivor of the 1700 earthquake (p. 97).

Authors 著者紹介



Brian Atwater, Musumi-Rokkaku Satoko, Satake Kenji, Tsuji Yoshinobu, Ueda Kazue, and David Yamaguchi. Tokyo, 2004.

THE STORY OF THE 1700 TSUNAMI draws on human history interpreted from old Japanese documents, on natural history inferred from North American sediments, trees, and native legends, and on mathematical modeling of tsunamis. The authors pooled their backgrounds in these and other fields. Below, as on the cover and title page, their names appear alphabetically.

Brian F. ATWATER ブライアン・F・アトウォーター conceived of the book and led in its preparation. To this work he brought over a decade of experience with geologic records of the 1700 earthquake and tsunami in North America. Through field work in 1999 he also contributed to size estimates for the 1700 tsunami in Japan. He holds B.S. and M.S. degrees in geology from Stanford University and a Ph.D. in geology from the University of Delaware. In thirty years with the U.S. Geological Survey he has studied bay and river geology in California, ice-age floods in Washington, and geologic records of earthquakes and tsunamis in the United States, Chile, and Japan. He lives in Seattle and is based at the University of Washington.

MUSUMI-ROKKAKU Satoko 六角 聡子 guided the transliteration and translation of the tsunami accounts. She also contributed to interviews in northeast Japan and to historical background material. Her education includes a B.A. in Humanities at Tokyo's International Christian University and an ensuing year as a Fulbright Fellow at the University of Chicago, where she did graduate work in Islamic cultural history and Arabic language. Since 1979 she has coordinated the United Nations University fellowship program for Asian food scientists while teaching at Tokyo's Obirin University. She has served as an officer in the UNU Women's Association and holds an honorary professorship at the Mongolian University of Science and Technology. Her travels have taken her to 33 countries.

SATAKE Kenji 佐竹 健治 estimated sizes of the 1700 tsunami in Japan and the 1700 earthquake at Cascadia. He also tracked down primary sources for accounts of the 1700 tsunami in Tsugaruishi and Nakaminato. These contributions stem from his broad interest in subduction-zone earthquakes, which he studies with instrumental, written, and geological records, and with geophysical modeling. He holds B.S. and M.S. degrees in geophysics from Hokkaido University and a Ph.D. in geophysics from the University of Tokyo. He spent seven years in the United States, as a postdoctoral researcher at the California Institute of Technology and as an assistant professor at the University of Michigan. Since 1995 he has worked at the Geological Survey of Japan, where he is now deputy director of the Active Fault Research Center of the National Institute of Advanced Industrial Science and Technology. His field work in 2005 included post-tsunami surveys in Myanmar and Thailand. He chairs the tsunami commission of the International Union of Geodesy and Geophysics, serves on governmental committees that evaluate earthquake hazards in Japan, and edits "Rekishi Jishin," the journal of Japan's Society of Historical Earthquake Studies.

TSUJI Yoshinobu 都司 嘉宣 identified places reached by the 1700 tsunami, computed tides for estimates of the tsunami's height, and helped transliterate and translate the tsunami accounts. From the University of Tokyo he earned a B.S. in civil engineering, and M.S. and Ph.D. degrees in geophysics. His studies of Japan's historical earthquakes and tsunamis began in the 1970s, when he worked for the National Research Center for Disaster Prevention. In 1987 he joined the faculty of the University of Tokyo's Earthquake Research Institute. He subsequently participated in post-tsunami field surveys in Nicaragua and Papua New Guinea, and he led such surveys in 2005 in Aceh and Thailand. He has also investigated storm surges and tsunami-induced damage to buildings. His second languages include Korean, Chinese, Russian, English, and Fortran.

UEDA Kazue 上田 和枝 discovered, transliterated, and translated accounts of the 1700 tsunami. She also confirmed the tsunami's misdating in Moriai-ke "Nikki Kakitome-chō" (p. 53), investigated the historical context of the tsunami's accounts, and interviewed witnesses to the 1960 tsunami. For over thirty years she has specialized in the written records of Japanese earthquakes. She entered that field eleven years after earning a B.A. in psychology at Tokyo Woman's Christian College and joining the Earthquake Research Institute, University of Tokyo. The 21-volume, 16,812-page earthquake anthology, "Shinshū Nihon jishin shiryō" (p. 123), resulted largely from her efforts. These included some 300 visits to libraries, prominent families, government offices, temples, and shrines where she searched thousands of pages daily for accounts of earthquakes and tsunamis. Since retiring from the Earthquake Research Institute in 1998 she has remained active in meetings and publications on Japan's historical earthquakes.

David K. YAMAGUCHI デイビッド・K・ヤマグチ relentlessly revised the entire book for presentation and content. He also contributed tree-ring dates, photographs, and bilingual interviews in Tsugaruishi, Miho, and Tanabe. A Seattle-born grandson of Japanese immigrants, he earned a B.S. in biology at Yale and a Ph.D. in forestry at the University of Washington. While a graduate student, he dated two eruptions of Mount St. Helens to 1479-1482 from the thin rings of trees damaged downwind. These findings led to a postdoctoral fellowship with the U.S. Geological Survey, where he dated volcanic debris flows by matching the ring-width patterns of entombed trees with those of living ones. During that fellowship he began the coastal tree-ring studies that helped identify Cascadia as the source of the orphan tsunami (p. 24, 96-97). Those studies progressed while he served on the research faculty of the University of Colorado and worked as a visiting scholar at the Forestry and Forest Products Research Institute, Hokkaido. Later he became a financial advisor at Merrill Lynch and a public-health statistician at the University of Washington's School of Dentistry. He now analyzes public-health data as a programmer at the Center for Health Studies, Group Health Cooperative, Seattle.

References 文献

*〔御番所日記〕
十月十三日 午ノ下刻少地震、主膳伺公、

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十二月八日潮水非常ニ增長

元禄十二年（西曆一七〇〇）十二月陸中大槌津浪アリ、

*〔大槌記録抄〕
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馬怪我なし

元禄十二年十二月廿三日（西曆一七〇〇）加賀國金沢卯辰
山再ビ崩壊シ、壓死者三十一人、家屋倒壊若干ヲ出セ
リ、

*〔前田家乘〕十二月廿三日申刻、卯辰山破壊シ、浅野
川ヲ塞ク、壓死三十一人、
*〔三州志來回觀覽町録〕十二月二十三白申時、城東茶
臼山崩壊シ、浅野川塞ル、壓死三十一人、壓家若干
也、略中町夫毎百千人ヲ以テ晝夜水道ヲ鑿ツ、
*〔變異記〕十二月廿三日申ノ刻、卯辰茶臼山崩テ浅野

Two accounts of the 1700 tsunami were first published in Musha Kinkichi's second volume of collected materials on Japanese historical earthquakes. The accounts, boxed above, are quoted on page 62. The volume is listed in the references by its corporate author, Mombushō Shinsai Yobō Hyōgikai.

Mombushō Shinsai Yobō Hyōgikai (1943, p. 25).

A

- Abe, K., 1979, Size of great earthquakes of 1837-1974 inferred from tsunami data: *Journal of Geophysical Research*, v. 84, p. 1561-1568. {footnoted on our page 49}
- Adams, J., 1990, Paleoseismicity of the Cascadia subduction zone—evidence from turbidites off the Oregon-Washington margin: *Tectonics*, v. 9, p. 569-583. {22, 101}
- Adams, J., and Atkinson, G., 2003, Development of seismic hazard maps for the proposed 2005 edition of the National Building Code of Canada: *Canadian Journal of Civil Engineering*, v. 30, p. 255-271. {105}
- Akioka, T., 1997, *Nihon chizu shi* [History of Japanese maps]: Tokyo, Myūjiamu Tosho, 339 p. [in Japanese] {31}
- All Japan Handmade Washi Association, 1991, *Handbook on the art of washi*: Tokyo, Wagami-do K.K., 125 p. {87}
- Ando, M., 1975, Source mechanisms and tectonic significance of historical earthquakes along the Nankai Trough, Japan: *Tectonophysics*, v. 27, p. 119-140. {85, 91, 101}
- Ando, M., and Balazs, E.I., 1979, Geodetic evidence for aseismic subduction of the Juan de Fuca plate: *Journal of Geophysical Research*, v. 84, p. 3023-3028. {109}
- Andō, S., and Wakayama-ken Tanabe-shi Kyōiku I'inkai, editors, 1991-1994, *Kishū Tanabe mandaiki*: Osaka, Seibundō Shuppan, 18 volumes, 10,200 p. [in Japanese]. {84}
- Anonymous, editor, 1995, *Sumpuki*: Tokyo, Zoku Gunshoruijū Kanseikai, 319 p. [in Japanese]. {41}
- Arakawa, H., and Taga, S., 1969, *Climate of Japan*, in Arakawa, H., *Climates of northern and eastern Asia*: Amsterdam, Elsevier, *World survey of climatology* v. 8, p. 119-158. {72, 83}
- Arakawa, H., Ishida, Y., and Itō, T., editors, 1961, *Nihon takashio shiryō* [Historical materials on storm surges in Japan]: Meteorological Research Institute, 272 p. [in Japanese]. {83}
- Ashida Bunko Hensan I'inkai [Ashida Collection Editorial Committee], 2004, *Ashida bunko mokuroku kochizu hen* [Index to the Ashida collection of old maps]: Tokyo, Meiji University, *Jimbunkagaku Kenkyūsho* [Humanities Research Center], 329 p. [in Japanese]. {32, 76}
- Aston, W.G., translator, 1972, *Nihongi*; chronicles of Japan from the earliest times to A.D. 697, volume 2: Rutland, Vermont, and Tokyo, Charles E. Tuttle, 443 p. {54}
- Atkinson, G.M., and Boore, D.M., 2003, Empirical ground-motion relations for subduction-zone earthquakes and their application to Cascadia and other regions: *Bulletin of the Seismological Society of America*, v. 93, p. 1703-1729. {104}
- Atkinson, G.M., and Casey, R., 2003, A comparison of ground motions from the 2001 M 6.8 in-slab earthquakes in Cascadia and Japan: *Bulletin of the Seismological Society of America*, v. 93, p. 1823-1831. {104}
- Atwater, B.F., and Hemphill-Haley, E., 1997, Recurrence intervals for great earthquakes of the past 3,500 years at northeastern Willapa Bay, Washington: *U.S. Geological Survey Professional Paper 1576*, 108 p. {18, 21, 24}

CITATION ORDER for entries with the same first author (Jones): (1) publications by Jones alone, arranged by year; (2) publications by Jones and one other author, arranged alphabetically by second author, then by year; and (3) papers by Jones and two or more coauthors, arranged by year alone. In the book's footnotes, these publications would be attributed to (1) Jones, (2) Jones and Smith, and (3) Jones and others.

DIVISION BETWEEN TITLE AND SUBTITLE is marked here by a semi-colon if denoted in the original by a colon or font change.

- Atwater, B.F., and Yamaguchi, D.K., 1991, Sudden, probably coseismic submergence of Holocene trees and grass in coastal Washington State: *Geology*, v. 19, p. 706-709. {17}
- Atwater, B.F., Stuiver, M., and Yamaguchi, D.K., 1991, Radiocarbon test of earthquake magnitude at the Cascadia subduction zone: *Nature*, v. 353, p. 156-158. {25}
- Atwater, B.F., Yelin, T.S., Weaver, C.S., and Hendley, J.W., III, 1995, Averting surprises in the Pacific Northwest: *U.S. Geological Survey Fact Sheet 111-95*, 2 p. [<http://quake.wr.usgs.gov/prepare/factsheets/PacNW/>]. {104}
- Atwater, B.F., Cisternas V., M., Bourgeois, J., Dudley, W.C., Hendley, J.W. II, and Stauffer, P.H., 1999, Surviving a tsunami—lessons from Chile, Hawaii, and Japan: *U.S. Geological Survey Circular 1187*, 18 p. [pubs.usgs.gov/circ/c1187/]; in Spanish, as *U.S. Geological Survey Circular 1218*, <http://pubs.usgs.gov/circ/c1218/>. {5, 11, 49, 80}
- Atwater, B.F., Baker, D., Barnhardt, W.A., Burrell, K.S., Haraguchi, T., Higman, B., Kayen, R.E., Minasian, D., Nakata, T., Satake, K., Shimokawa, K., Takada, K., and Cisternas V., M., 2001a, Grouted sediment slices show signs of earthquake shaking: *Eos*, v. 82, p. 603, 608. {23}
- Atwater, B.F., Yamaguchi, D.K., Bondevik, S., Barnhardt, W.A., Amidon, L.J., Benson, B.E., Skjerdal, G., Shulene, J.A., and Nanayama, F., 2001b, Rapid resetting of an estuarine recorder of the 1964 Alaska earthquake: *Geological Society of America Bulletin*, v. 113, p. 1193-1204. {14}
- Atwater, B.F., Tuttle, M.P., Schweig, E.S., Rubin, C.M., Yamaguchi, D.K., and Hemphill-Haley, E., 2004, Earthquake recurrence inferred from paleoseismology, in Gillespie, A.R., Porter, S.C., and Atwater, B.F., editors, *The Quaternary Period in the United States*: Amsterdam, Elsevier, p. 331-350. {16, 100, 101}

B

- Bache, A.D., 1856, Notice of earthquake waves on the western coast of the United States, on the 23d and 25th of December, 1854: *American Journal of Science and Arts*, second series, v. 21, p. 37-43. [text published also in Report of the Superintendent of the Coast Survey showing the progress of the Survey during the year 1855: 34th Congress, 1st Session, Ex. Doc. 22, p. 342-346 http://docs.lib.noaa.gov/rescue/cgs/001_pdf/CSC-0004.pdf] {91}



A village elder saves his fellow villagers from a tsunami in a story that was introduced to Japanese school-children in the 1930s and 1940s (textbook cover, left). Inspired by real events in 1854 (p. 47), the plot runs through video frames on succeeding pages. Related references are listed under the author names Hearn, Hodges, Shimizu, and Tsumura.

- Ballantyne, D., Bartoletti, S., Chang, S., Graff, B., MacRae, G., Meszaros, J., Pearce, I., Pierepiekarz, M., Preuss, J., Stewart, M., Swanson, D., and Weaver, C., 2005, Scenario for a magnitude 6.7 earthquake on the Seattle fault: Earthquake Engineering Research Institute and Washington Emergency Management Division [<http://seattlescenario.eeri.org/documents/EQ%20-28%20Booklet.pdf>]. {104}
- Bartsch-Winkler, S.R., 1988, Cycle of earthquake-induced aggradation and related tidal channel shifting, upper Turnagain Arm, Alaska, USA: *Sedimentology*, v. 35, p. 621-628. {14}
- Beasley, W.G., 1982, The modern history of Japan, third revised edition: Tokyo, Charles E. Tuttle, 358 p. {45}
- Beck, J.L., and Hall, J.F., 1986, Factors contributing to the catastrophe in Mexico City during the earthquake of September 19, 1985: *Geophysical Research Letters*, v. 13, p. 593-596. {8}
- Ben-Menahem, A., and Rosenman, M., 1972, Amplitude patterns of tsunami waves from submarine earthquakes: *Journal of Geophysical Research*, v. 77, p. 3097-3128. {54}
- Benson, B.E., Atwater, B.F., Yamaguchi, D.K., Amidon, L.J., Brown, S.L., and Lewis, R.C., 2001, Renewal of tidal forests in Washington state after a subduction earthquake in A.D. 1700: *Quaternary Research*, v. 56, p. 139-147. {96}
- Bernard, E.N., Mader, C., Curtis, G., and Satake, K., 1994, Tsunami inundation model study of Eureka and Crescent City, California: National Oceanic and Atmospheric Administration, Environmental Research Laboratories, Pacific Marine Environmental Laboratory, PMEL Technical Memorandum ERL PMEL 103, 80 p. {102}
- Berry, M.E., 1982, *Hideyoshi*: Cambridge, Mass., Harvard University Press, 293 p. {86}
- Bilham, R., Engdahl, R., Feldl, N., and Satyabala, S.P., 2005, Partial and complete rupture of the Indo-Andaman plate boundary 1847-2004: *Seismological Research Letters*, v. 76, p. 299-311. {5, 101}
- Bolitho, H., 1976, The dog shogun, *in* Wang, G.W., editor, *Self and biography, essays on the individual and society in Asia*: Sydney, Sydney University Press for the Australian Academy of the Humanities, p. 123-139. {63}
- Bolitho, H., 1991, The han, *in* Hall, J.W., editor, and McClain, J.L., assistant editor, *The Cambridge history of Japan* (Hall, J.W., Jansen, M.B., Kanai, M., and Twitchett, D., general editors), volume 4, early modern Japan: Cambridge, U.K., Cambridge University Press, p. 183-234. {61}
- Boudonnat, L., and Kushizaki, H., 2003, *Traces of the brush: the art of Japanese calligraphy*: Paris, Éditions du Seuil, and San Francisco, Chronicle Books, 215 p. [translated by C. Penwarden from *Au fil du pinceau, la calligraphie japonaise*]. {87}
- Brocher, T.M., Parsons, T., Tréhu, A.M., Snelson, C.M., and Fisher, M.A., 2003, Seismic evidence for widespread serpentinized forearc upper mantle along the Cascadia margin: *Geology*, v. 31, p. 267-270. {104}
- Bryant, E., 2001, *Tsunami: the underrated hazard*: Cambridge, U.K., Cambridge University Press, 320 p. {11}
- Bucknam, R.C., Hemphill-Haley, E., and Leopold, E.B., 1992, Abrupt uplift within the past 1700 years at southern Puget Sound, Washington: *Science*, v. 258, p. 1611-1614. {104}
- Building Seismic Safety Council, 2001, NEHRP recommended provisions (National Earthquake Hazard Reduction Program) for seismic regulations for new buildings and other structures, 2000 edition, part 1: provisions (FEMA [Federal Emergency Management Agency] 368): Washington, D.C., Building Seismic Safety Council, 374 p. {104}
- ## C
- Cascadia Region Earthquake Workgroup, 2005, Cascadia subduction zone earthquakes; a magnitude 9.0 earthquake scenario: Seattle, Cascadia Region Earthquake Workgroup, 21 p. [<http://www.crew.org/papers/CREWCascadiaFinal.pdf>] [also available as Oregon Department of Geology and Mineral Industries Open-file Report 05-05]. {5, 104}
- Cazenave, A., and Nerem, R.S., 2004, Present-day sea level change; observations and causes: *Reviews of Geophysics*, v. 42, 2003RG000139. {65}
- The Central Meteorological Observatory, 1953, Shōwa 27-nen 11-gatsu Kamchatka jishin chōsa hōkoku [Report of investigation of the 1952 Kamchatka earthquake]: *Quarterly Journal of Seismology*, v. 18, no. 1, 48 p. [in Japanese]. {37, 51, 54, 59, 94, 95}
- Chamberlain, B.H., 1905, *Things Japanese; being notes on various subjects connected with Japan for the use of travellers and others*, fifth edition revised: London, J. Murray, 568 p. [reprinted, as "Japanese things," in 1971 by Charles E. Tuttle, Co., Rutland, Vermont, and Tokyo]. {43, 87}
- Chibbett, D.G., 1977, *The history of Japanese printing and book illustration*: Tokyo and New York, Kodansha, 264 p. {29}
- Cifuentes, I., 1989, The 1960 Chilean earthquakes: *Journal of Geophysical Research*, v. 94, p. 665-680. {9}
- Cisternas [V.], M., Atwater, B.F., Torrejón, F., Sawai, Y., Machuca, G., Lagos, M., Eipert, A., Youlton, C., Salgado, I., Kamataki, T., Shishikura, M., Rajendran, C.P., Malik, J.K., Rizal, Y., and Husni, M., 2005, Predecessors to the giant 1960 Chile earthquake: *Nature*, v. 437, p. 404-407. {19}
- Clague, J.J., and Bobrowsky, P.T., 1994, Tsunami deposits beneath tidal marshes on Vancouver Island, British Columbia: *Geological Society of America Bulletin*, v. 106, p. 1293-1303. {101}
- Clague, J.J., Bobrowsky, P.T., and Hutchinson, I., 2000, A review of geological records of large tsunamis at Vancouver Island, British Columbia, and implications for hazard: *Quaternary Science Reviews*, v. 19, p. 849-863. {18}
- Clarke, S.H., Jr., and Carver, G.A., 1992, Late Holocene tectonics and paleoseismicity, southern Cascadia subduction zone: *Science*, v. 255, p. 188-192. {101}
- Coastal Movements Data Center, 1996, Tables and graphs of annual mean sea level along the Japanese coast 1894~1995: Tsukuba, Geographical Survey Institute, 113 p. {65}
- Cole, S.C., Atwater, B.F., McCutcheon, P.T., Stein, J.K., and Hemphill-Haley, E., 1996, Earthquake-induced burial of archaeological sites along the southern Washington coast about A.D. 1700: *Geoarchaeology*, v. 11, p. 165-177. {20}
- Combellick, R.A., 1991, Paleoseismicity of the Cook Inlet region, Alaska; evidence from peat stratigraphy in Turnagain and Knick Arms: Alaska Division of Geology and Geophysical Surveys Professional Report 112, 52 p. {95}
- The Committee for Field Investigation of the Chilean Tsunami of 1960, 1961, Report on the Chilean tsunami of May 24, 1960, as observed along the coast of Japan: Tokyo, Maruzen Co., Ltd., 1961, 397 p. {37, 49, 51, 55, 56, 57, 73, 83}
- Cooper, J.G., 1860, Report upon the botany of the route, *in* Reports of explorations and surveys to ascertain the most practicable and economical route for a railroad from the Mississippi River to the

Pacific Ocean, v. XII, book II: 36th Congress, 1st session, House of Representatives, Ex. doc. no. 56, p. 13-39. {16}
Cox, D.C., 2001, The inappropriate tsunami icon: Science of Tsunami Hazards, v. 19, p. 87-92
[<http://epubs.lanl.gov/tsunami/5092.pdf>]. {80}

D

Dariento, M.E., and Peterson, C.D., 1995, Magnitude and frequency of subduction-zone earthquakes along the Oregon coast in the past 3,000 years: *Oregon Geology*, v. 57, p. 3-12. {101}
Doig, I., 1980, Winter brothers; a season at the edge of America: New York, Harcourt Brace Jovanovich, 246 p. {12}
Dragert, H., and Hyndman, R.D., 1995, Continuous GPS monitoring of elastic strain in the northern Cascadia subduction zone: *Geophysical Research Letters*, v. 22, p. 755-758. {99}
Dragert, H., Wang, K., and James, T.S., 2001, A silent slip event on the deeper Cascadia subduction interface: *Science*, v. 292, p. 1525-1528. {99}
Dudley, W.C., and Lee, M., 1998, *Tsunami!* Honolulu, University of Hawai'i Press, 362 p. {11}

E

Earthquake Research Committee, 1998, Seismic activity in Japan — regional perspectives on the characteristics of destructive earthquakes — (excerpt): Tokyo, Science and Technology Agency, 222 p. (prepared by Earthquake Research Committee, Headquarters for Earthquake Research Promotion, Prime Minister's Office; translated by Earthquake Research Center, Association for the Development of Earthquake Prediction). {65}
Endō, S., and Nagasawa, K., editors, 1989, *Miho chiku no rekishi, soko ga shiritai* [Miho district history, what I want to know]: Shimizu-shi Miho Kōminkan [Shimizu City, Miho Community Center] and Miho Chiku Machi Zukuri Suishin I'inkai [Miho District Town Development Promotion Commission], 48 p. + appendices [in Japanese]. {76, 82}
Endō, S., Nagasawa, K., and Suzuki, M., editors, 1990, *Miho chiku no rekishi, soko ga shiritai* [Miho district history, what I want to know]: Shimizu-shi Miho Kōminkan [Shimizu City, Miho Community Center] and Miho Chiku Machi Zukuri Suishin I'inkai [Miho District Town Development Promotion Commission], 121 p. + appendices [in Japanese]. {76}

F

Frankel, A.[D.], Mueller, C., Barnhard, T., Perkins, D., Leyendecker, E.V., Dickman, N., Hanson, S., and Hopper, M., 1996, National seismic hazard maps, June 1996 documentation: U.S. Geological Survey Open-File Report 96-532, 69 p.
[<http://eqhazmaps.usgs.gov/hazmapsdoc/junecover.html>] {105}
Frankel, A.D., Carver, D.L., and Williams, R.A., 2002a, Nonlinear and linear site response and basin effects in Seattle for the M 6.8 Nisqually, Washington, earthquake: *Bulletin of the Seismological Society of America*, v. 92, p. 2090-2109. {104}
Frankel, A.D., Petersen, M.D., Mueller, C.S., Haller, K.M., Wheeler, R.L., Leyendecker, E.V., Wesson, R.L., Harmsen, S.C., Cramer, C.H., Perkins, D.M., and Rukstales, K.S., 2002b, Documentation for the 2002 update of the national seismic hazard maps: U.S. Geological Survey Open-File Report 02-420, 33 p.
[<http://pubs.usgs.gov/of/2002/ofr-02-420/>] {105}

French, J., editor, 1999, *Tooley's dictionary of mapmakers*, revised edition A-D: Herts, England, Map Collector Publications, 408 p. {5}
Fritts, H.C., 1976, *Tree rings and climate*: London, Academic Press, 576 p. [reprinted in 2001 by Blackburn Press, Caldwell, New Jersey]. {97}

G

García, V., and Suárez, G., 1996, Los sismos en la historia de México: México [City], Universidad Nacional Autónoma de México, 718 p. [in Spanish]. {94}
Garruth, G., 1993, *The encyclopedia of world facts and dates*: New York, Harper Collins, 1310 p. {5}
Goldfinger, C., Nelson, C.H., and Johnson, J.E., 2003, Holocene earthquake records from the Cascadia subduction zone and northern San Andreas fault based on precise dating of offshore turbidites: *Annual Reviews of Earth and Planetary Science*, v. 31, p. 555-577. {22}
González, F.I., 1984, Case study of wave-current-bathymetry interactions at the Columbia River entrance: *Journal of Physical Oceanography*, v. 14, p. 1065-1078. {73}
Goodman, L.J., and Swan, H., 2003, Singing the songs of my ancestors; the life and music of Helma Swan, Makah elder: Norman, Oklahoma, University of Oklahoma Press, 339 p. {12}
Grant, W.C., 1992, Paleoseismic evidence for late Holocene episodic subsidence on the northern Oregon coast: Seattle, University of Washington unpublished M.S. non-thesis report, 39 p. {21}

H

Hachinohe Komonjo Benkyōkai [Hachinohe Old-Documents Study Group], editor and publisher, 1994, Nambu-han "Han nikki" metsukesho kanjōsho kaidoku [Deciphering the official records of the inspection bureau and finance office of the Nambu Hachinohe domain], in *Shoshanbun* [Transcribed documents], v. 5 [for the year Genroku 12]: Hachinohe, Aomori Prefecture, 208 p. {52}
Hall, J.W., 1991, Introduction, in Hall, J.W., editor, and McClain, J.L., assistant editor, *The Cambridge history of Japan* (Hall, J.W., Jansen, M.B., Kanai, M., and Twitchett, D., general editors), volume 4, early modern Japan: Cambridge, U.K., Cambridge University Press, p. 1-39. {86}
Hall, R., and Radosevich, S.C., 1998, Geoarchaeological analysis of a site in the Cascadia subduction zone on the southern Oregon coast: *Northwest Anthropological Research Notes*, v. 29, p. 123-140. {20}
Hamilton, S.L., and Shennan, I., 2005, Late Holocene land and sea-level changes and the earthquake deformation cycle around upper Cook Inlet, Alaska: *Quaternary Science Reviews*, v. 24, doi:10.1016/j.quascirev.2004.11.003. {95}



One autumn evening at his clifftop home, a village headman feels an earthquake. Fearing a tsunami, he studies the sea.

- Hanasaka, K., editor, 1974, Miyako no ayumi [Historical development of Miyako]: Miyako Kyōdoshi Henshū I'inkai [Miyako Document Editing Committee], Miyako Shiyakusho [Miyako City Hall], 126 p. [in Japanese]. {39, 49}
- Hanley, S.B., and Yamamura, K., 1977, Economic and demographic change in preindustrial Japan, 1600-1868: Princeton, N.J., Princeton University Press, 409 p. {36, 44, 53, 61}
- Haring, C.H., 1963, The Spanish empire in America: New York, Harcourt, 371 p. {94}
- Harmsen, S.C., Frankel, A.D., and Petersen, M.D., 2003, Deaggregation of U.S. seismic hazard sources: the 2002 update: U.S. Geological Survey Open-file Report 03-440, 33 p. [<http://pubs.usgs.gov/of/2003/ofr-03-440/>]. {105}
- Hatori, T., 1965, On the Alaska tsunami of March 28, 1964, as observed along the coast of Japan: Bulletin of the Earthquake Research Institute, v. 43, p. 399-408. {54, 94, 95}
- Hatori, T., 1976, Documents of tsunami and crustal deformation in Tokai district associated with the Ansei earthquake of Dec. 23, 1854: Bulletin of the Earthquake Research Institute, v. 51, p. 13-28 [in Japanese with English abstract and captions]. {77, 82}
- Hatori, T., 1995, Field investigation of the 1611 Keicho [Keichō] Sanriku tsunami along the Iwate coast, NE Japan: Rekishi Jishin [Historical Earthquakes], v. 11, p. 59-66 [in Japanese with English captions]. {37, 41, 51, 59}
- Hayes, D., 1999, Historical atlas of the Pacific Northwest; maps of exploration and discovery; British Columbia, Washington, Oregon, Alaska, Yukon: Seattle, Sasquatch Books, 208 p. [reprinted with revision, 2000]. {12}
- Hearn, L., 1897, Gleanings in Buddha-fields: studies of hand and soul in the Far East: Boston, Houghton, Mifflin, 296 p. [reprinted in 1971 by Charles E. Tuttle, Co., Rutland, Vermont, and Tokyo, 296 p.] {47}
- Heaton, T.H., and Hartzell, S.H., 1986, Source characteristics of hypothetical subduction earthquakes in the northwestern United States: Bulletin of the Seismological Society of America, v. 76, p. 675-708. {8}
- Heaton, T.H., and Hartzell, S.H., 1987, Earthquake hazards on the Cascadia subduction zone: Science, v. 236, p. 162-168. {8}
- Heaton, T.H., and Hartzell, S.H., 1989, Estimation of strong ground motions from hypothetical earthquakes on the Cascadia subduction zone, Pacific Northwest: Pure and Applied Geophysics, v. 129, p. 131-201. {104}
- Heki, K., 2004, Space geodetic observation of deep basal subduction erosion in northeastern Japan: Earth and Planetary Science Letters, v. 219, p. 13-20. {65}
- Hemphill-Haley, E., 1996, Diatoms as an aid in identifying late-Holocene tsunami deposits: The Holocene, v. 6, p. 439-448. {18}
- Hibiya, T., and Kajiura, K., 1982, Origin of the abiki phenomenon (a kind of seiche) in Nagasaki Bay: Journal of the Oceanographical Society of Japan, v. 38, p. 172-182. [<http://www.terrapub.co.jp/journals/JO/JOSJ/toc/3803.html>]. {86}
- Hodges, M., 1964, The wave; adapted from Lafcadio Hearn's Gleanings in Buddha-fields, illustrated by Blair Lent: Boston, Houghton Mifflin Co., 45 p. [reprinted in 1997 by Harcourt School Publishers, Orlando, Florida, 48 p.]. {47}
- Hoshikawa, M., and Maezawa, T., 1984-1985, Nambu-han sankō sho-kakei-zu [Family histories in Nambu-han]: Tokyo, Kokusho Kankō-kai, five volumes, 2,809 p. [in Japanese]. {44}
- Hosoi, K., 1988, Morioka-han, in Kimura, M., Fujino, T., and Murakami, T., editors, Han-shi daijiten dai 1-kan, Hokkaido, Tōhoku hen [Encyclopedia of the history of ruling clans and their Edo-period domains, v. 1, Hokkaido and Tōhoku]: Tokyo, Yūzan Kaku, p. 56-80 [in Japanese]. {44, 61}
- Hutchinson, I., Clague, J.J., and Mathewes, R.W., 1997, Reconstructing the tsunami record on an emerging coast; a case study of Kanim Lake, Vancouver Island, British Columbia: Journal of Coastal Research, v. 13, p. 545-553. {18}
- Hyndman, R.D., 1995, Giant earthquakes of the Pacific Northwest: Scientific American, v. 273, p. 50-57. {8}
- I**
- Ishibashi, K., 1981, Specification of a soon-to-occur seismic faulting in the Tokai district, central Japan, based upon seismotectonics, in Simpson, D.W., and Richards, P.G., editors, Earthquake prediction, an international review: American Geophysical Union, Maurice Ewing series 4, p. 297-332. {77, 85}
- Ishibashi, K., 1984, Coseismic vertical crustal movements in the Suruga Bay region: Daiyonki Kenkyū (The Quaternary Research), v. 23, p. 105-110. [in Japanese with English abstract]. {82}
- Iwamoto, Y., 1970, Kinsei gyoson kyōdōtai no hensen katei — shōhin keizai no shinten to sonraku kyōdōtai — [Changing course of early modern fishing village communities— development of commercial economy and village communities]: Tokyo, Hanawa Shobō, 256 p. [in Japanese]. {36, 51, 53, 57}
- Iwamoto, Y., 1979, Nambu hanamagari no sake [Nambu crook-nose salmon]: Tokyo, Nihon Keizai Shimbunsha, 245 p. [in Japanese]. {53}
- J**
- Jacoby, G.[C.], Carver, G.[A.], and Wagner, W., 1995, Trees and herbs killed by an earthquake ~300 yr ago at Humboldt Bay, California: Geology, v. 23, p. 77-80. {17}
- Jacoby, G.C., Bunker, D.E., and Benson, B.E., 1997, Tree-ring evidence for an A.D. 1700 Cascadia earthquake in Washington and northern Oregon: Geology, v. 25, p. 999-1002. {96, 97}
- Japan Meteorological Agency, 1960, Tide tables for the year 1961: Japan Meteorological Agency, 402 p. [in Japanese and English]. {48}
- Japan Meteorological Agency, 1961, The report on the tsunami of the Chilean earthquake, 1960: Technical Report of the Japan Meteorological Agency No. 8, 389 p. [in Japanese; cited on p. 46 as JMA, 1961]. {46, 51, 55, 56, 83, 85, 89}
- Japan Meteorological Agency, 1996, Tide tables for the year 1997: Japan Meteorological Agency, 271 p. [in Japanese and English]. {48}
- Jishin Yochi Sōgō Kenkyū Shinkōkai Jishin Chōsa Kenkyū Sentā [Association for the Development of Earthquake Prediction, Earthquake Research Center], undated, Daijishin no ato, yoshin wa dō naru ka [What aftershocks will follow a big earthquake?]: prepared for Kagaku Gijutsu Chō [Science and Technology Agency] [in Japanese]. {41}
- Johnson, A.C., 1990, An earthquake strength scale for the media and the public: Earthquakes and Volcanoes, v. 22, p. 214-216. {98}
- Johnson, J.M., and Satake, K., 1999, Asperity distribution of the 1952 great Kamchatka earthquake and its relation to future earthquake potential in Kamchatka: Pure and Applied Geophysics, v. 154, p. 541-553. {49}

- Johnson, J.M., Tanioka, Y., Ruff, L.J., Satake, K., Kanamori, H., and Sykes, L.R., 1994, The 1957 great Aleutian earthquake: Pure and Applied Geophysics, v. 142, p. 3-28. {98}
- Johnson, S.Y., Dadisman, S.V., Mosher, D.C., Blakely, R.J., and Childs, J.R., 2001, Active tectonics of the Devils Mountain fault and related structures, northern Puget lowland and eastern Strait of Juan de Fuca region, Pacific Northwest: U.S. Geological Survey Professional Paper 1643, 45 p. {104}
- K**
- Kaizuka, S., Koike, K., Endō, K., Yamazaki, H., and Suzuki, T., editors, 2000, Kanto, Izu, Ogasawara [v. 4 of Nihon no chikei (Regional geomorphology of the Japanese Islands)]: Tokyo, University of Tokyo Press, 349 p. [in Japanese]. {66}
- Kajiura, K., Hatori, T., Aida, I., and Koyama, M., 1968, A survey of a tsunami accompanying the Tokachi-oki earthquake of May, 1968: Bulletin of the Earthquake Research Institute, v. 46, p. 1397-1413 [in Japanese with English abstract and figures]. {37, 51, 59}
- Kanamori, H., 1977, The energy release in great earthquakes: Journal of Geophysical Research, v. 82, p. 2981-2987. {98}
- Kanamori, H., and Heaton, T.H., 1996, The wake of a legendary earthquake: Nature, v. 379, p. 203-204 [commentary introducing report by Satake and others (1996)]. {94}
- Kanamori, H., and McNally, K.C., 1982, Variable rupture mode of the subduction zone along the Ecuador-Colombia coast: Bulletin of the Seismological Society of America, v. 72, p. 1241-1253. {101}
- Kato, S., 1979a, A history of Japanese literature; 2, the years of isolation: Tokyo, Kodansha, 230 p. [Sanderson, D., translator] {63}
- Kato, T., 1979b, Crustal movements in the Tohoku district, Japan, during the period 1900-1975, and their tectonic implications: Tectonophysics, v. 60, p. 141-167. {65}
- Katō, Y., Suzuki, Z., Nakamura, K., Takagi, A., Emura, K., Ito, M., and Ishida, H., 1961, The Chile tsunami of May 24, 1960 observed along the Sanriku coast, Japan, in Report on the Chilean tsunami of May 24, 1960, as observed along the coast of Japan: Tokyo, Maruzen Co., Ltd., p. 67-76. {51}
- Kawana, N., 1984, Kinsei Nihon suiunshi no kenkyū [Studies of water-transport history of early modern Japan]: Tokyo, Yūzan Kaku, 428 p. [in Japanese]. {66}
- Keightley, D.N., 1978, Sources of Shang history; the oracle-bone inscriptions of Bronze Age China: Berkeley, University of California Press, 281 p. {100}
- Kelsey, H.M., Witter, R.C., and Hemphill-Haley, E., 2002, Plate-boundary earthquakes and tsunamis of the past 5500 years, Sixes River estuary, southern Oregon: Geological Society of America Bulletin, v. 114, p. 298-314. {16, 22, 101}
- Kelsey, H.M., Nelson, A.R., Hemphill-Haley, E., and Witter, R.C., 2005, Tsunami history of an Oregon coastal lake reveals a 4600 yr record of great earthquakes on the Cascadia subduction zone: Geological Society of America Bulletin, v. 117, p. 1009-1032, doi: 10.1130/B25452.1. {101}
- Kerr, R.A., 1995, Faraway tsunami hints at a really big Northwest quake: Science, v. 267, p. 962 [news story on research later published by Satake and others (1996)]. {94}
- Kin'no, S., editor, 1981, Ezu ni miru hansei jidai no Kesen [Picture maps of Kesen in the time of Sendai-han]: Morioka, Kumagai Insatsu Shuppan-bu, 97 p. [in Japanese]. {81}
- Kitamura, N., Kotaka, T., and Kataoka, J., 1961a, Ōfunato-Shizugawa chiku chōsahan [Ōfunato-Shizugawa area investigation group], in Report on the Chilean tsunami of May 24, 1960, as observed along the coast of Japan: Tokyo, Maruzen Co., Ltd., p. 234-244 [in Japanese]. {51, 56}
- Kitamura, N., Kotaka, T., and Kataoka, J., 1961b, Ōfunato-Shizugawa chiku [Region between Ōfunato and Shizugawa], in Kon'no, E., editor, Geological observations of the Sanriku coastal region damaged by tsunami due to the Chile earthquake in 1960: Contributions to the Institute of Geology and Paleontology of Tohoku University, v. 52, p. 28-40 [in Japanese with English abstract, figures, and tables]. {19}
- Kon'no, E., editor, 1961, Geological observations of the Sanriku coastal region damaged by tsunami due to the Chile earthquake in 1960: Contributions to the Institute of Geology and Paleontology of Tohoku University, v. 52, p. 1-40 [in Japanese with English abstract, figures, and tables]. {56}
- Kroeber, A.L., 1976, Yurok myths: Berkeley, University of California Press, 488 p. {20}
- L**
- Lander, J.F., Lockridge, P.A., and Kozuch, M.J., 1993, Tsunamis affecting the west coast of the United States, 1806-1992: National Oceanic and Atmospheric Administration, National Geophysical Data Center Key to Geophysical Records Documentation no. 29, 242 p. {11, 43, 49, 80, 91}
- Lay, T., Kanamori, H., Ammon, C.J., Nettles, M., Ward, S.N., Aster, R.C., Beck, S.L., Bilek, S.L., Brudzinski, M.R., Butler, R., DeShon, H.R., Ekström, G., Satake, K., and Sipkin, S., 2005, The great Sumatra-Andaman earthquake of 26 December 2004: Science, v. 308, p. 1127-1133. {5, 98}
- Leonard, L.J., Hyndman, R.D., and Mazzotti, S., 2004, Coseismic subsidence in the 1700 great Cascadia earthquake; coastal estimates versus elastic dislocation models: Geological Society of America Bulletin, v. 116, p. 655-670; doi: 10.1130/B25369.1. {16}
- Liu, H., and Qiao, T., 1984, Liquefaction potential of saturated sand deposits underlying foundation of structure, in Proceedings of the Eighth World Conference on Earthquake Engineering, v. 3, p. 199-206. {23}
- Lockridge, P.A., 1985, Tsunamis in Peru-Chile: National Oceanic and Atmospheric Administration, World Data Center A for Solid Earth Geophysics, Report SE 39, 97 p. {54, 94}
- Lockridge, P.A., Whiteside, L.S., and Lander, J.F., 2002, Tsunamis and tsunami-like waves of the eastern United States: Science of Tsunami Hazards, v. 20, p. 120-157 [http://epubs.lanl.gov/tsunami/5103.pdf]. {11}



The sea withdraws. The villagers remain on low ground, too far to hear their headman. How can he save them?

- Lomnitz, C., 1970, Major earthquakes and tsunamis in Chile during the period 1535 to 1955: *Geologische Rundschau*, v. 59, p. 938-960. {94}
- Lowe, D.R., 1975, Water escape structures in coarse-grained sediment: *Sedimentology*, v. 22, p. 157-204. {23}
- Ludwin, R.S., Dennis, R., Carver, D., McMillan, A.D., Losey, R., Clague, J.J., Jonientz-Trisler, C., Bovechop, J., Wray, J., and James, K., 2005, Dating the 1700 Cascadia earthquake; great coastal earthquakes in native stories: *Seismological Research Letters*, v. 76, p. 140-148. {12}
- M**
- Maritime Safety Agency, 1998, Heisei 11 nen, chō seki hyō (1999 Tide Tables), Maritime Safety Agency Publication no. 781, v. 1. {73, 83, 88}
- Mazzotti, S., and Adams, J., 2004, Variability of near-term probability for the next great earthquake on the Cascadia subduction zone: *Bulletin of the Seismological Society of America*, v. 94, p. 1954-1959. {101}
- McCaffrey, R., and Goldfinger, C., 1995, Forearc deformation and great subduction earthquakes: implications for Cascadia offshore earthquake potential: *Science*, v. 267, p. 856-859. {25}
- McCulloch, D.S., and Bonilla, M.G., 1970, Effects of the earthquake of March 27, 1964, on the Alaska Railroad: U.S. Geological Survey Professional Paper 545-D, 161 p. {14}
- McDonald, L., 1972, Swan among the Indians; life of James G. Swan, 1818-1900: Portland, Oregon, Binford and Mort, 233 p. {12}
- Melbourne, T.I., Szeliga, W.M., Miller, M.M., and Santillan, V.M., 2005, Extent and duration of the 2003 Cascadia slow earthquake: *Geophysical Research Letters*, v. 32, L04301, doi:10.1029/2004GL021790. {99}
- Miller, M.M., Melbourne, T., Johnson, D.J., and Sumner, W.Q., 2002, Periodic slow earthquakes from the Cascadia subduction zone: *Science*, v. 295, p. 2423. {99}
- Minor, R., and Grant, W.C., 1996, Earthquake-induced subsidence and burial of late Holocene archaeological sites, northern Oregon coast: *American Antiquities*, v. 61, p. 772-781. {20}
- Miyako-shi Kyōiku I'inkai [Miyako City Board of Education], editor, 1981, Miyako-shishi, gyogyō kōeki [Miyako city history, fisheries]: Miyako-shi [Miyako city], 550 p. [in Japanese]. {71}
- Miyako-shi Kyōiku I'inkai [Miyako City Board of Education], editor, 1991, Miyako-shishi, nenpyō [Miyako city history, chronology]: Miyako-shi [Miyako city], 615 p. [in Japanese]. {38}
- Mofjeld, H.O., Foreman, M.G.G., and Ruffman, A., 1997, West coast tides during Cascadia subduction zone tsunamis: *Geophysical Research Letters*, v. 24, p. 2215-2218. {83}
- Mombushō Shinsai Yobō Hyōgikai [Ministry of Education, Earthquake Disaster Prevention Committee], editor, 1943, Zōtei Dai Nihon jishin shiryō, dai 2 kan [Additional materials on historical earthquakes in Imperial Japan, volume 2] [reprinted in 1975, Tokyo, Meihōsha], 754 p. [in Japanese]. {40, 62, 112}
- Mori, K., editor, 1963, Iwate kenshi [History of Iwate prefecture], v. 5, Iwate-kenshi kinsei hen 2 [Early modern history of Iwate prefecture], Morioka-han: Morioka-shi, Tōryō Insatsu, 1,590 p. [in Japanese]. {45, 61}
- Mori, K., 1972, Iwate-ken no rekishi [History of Iwate prefecture]: Tokyo, Yamakawa Shuppansha (series: Kenshi shiriizu 3), 320 p. [in Japanese]. {44, 61}
- Mori, K., 1983, Kunohe chihō-shi [Local history of Kunohe], Nihon hekichi no shiteki kenkyū [Historical studies of rural Japan], Mori Kahe'e chosakushū dai-9-kan [Collected works of Mori Kahe'e, book 9]: Tokyo, Hōsei Daigaku Shuppan-kyoku [Hōsei University Press], 1,351 p. (reprinted from Kunohe chihō shi, published in 1970 by Kunohe Chihōshi Kankōkai [Kunohe Local-History Publishing Association] of Kuji, Iwate Prefecture) [in Japanese]. {51, 52}
- Morioka-shi Chūō Kōminkan [Morioka City Central Community Center], editor, 1998, Nambu Morioka han no ōezu, yomigaeru Edo jidai no fūkei [Large drawings of Nambu- or Morioka-han: Edo-period landscapes brought back to life]: Morioka-shi Chūō Kōminkan (Morioka City Central Community Center), 36 p. [in Japanese; booklet about the drawings]. {44, 45}
- Morioka-shi Kyōiku I'inkai [Morioka City Board of Education] and Morioka-shi Chūō Kōminkan [Morioka City Community Center], editors, 1986-2001, Morioka-han zassho: Morioka, Kumagai Insatsu Shuppan-bu, 15 volumes [in Japanese; volume 7, 1083 p., published 1993, entries span Genroku 11-15]. {44}
- Morris, I., translator and editor, 1971, The pillow book of Sei Shōnagon: Baltimore, Harmondsworth, Penguin, 1971, 411 p. [reprinted in 1991, by Columbia University Press, New York] {43}
- Moss, M.L., and Erlandson, J.M., 1998, Comparative chronology of Northwest Coast fishing features, in Bernick, K., editor, Hidden dimensions; the cultural significance of wetland archaeology: Vancouver, British Columbia, UBC Press, p. 180-198. {21}
- Murty, T.S., 1977, Seismic sea waves; tsunamis: Ottawa, Canada, Department of Fisheries and the Environment, Fisheries and Marine Service, 337 p. {11}
- Myers, E.P., III, Baptista, A.M., and Priest, G.R., 1999, Finite element modeling of potential Cascadia subduction zone tsunamis: *Science of Tsunami Hazards*, v. 17, p. 3-18. [<http://epubs.lanl.gov/5071.pdf>]. {103}
- N**
- Nagaoka, T., 1986, Iwate-ken no kyōiku-shi [History of education in Iwate prefecture]: Kyoto, Shibunkaku Shuppan, 366 p. [in Japanese]. {45}
- Nagoya-shi Kyōiku I'inkai [Nagoya City Board of Education], 1965-1969, Ōmu rōchū ki: Nagoya, Nagoya-shi Kyōiku I'inkai, 4 volumes [in Japanese]. {72}
- Naitō, A., and Hozumi, K., 1982, Edo no machi (ge) kyodai toshi no hatten [Edo, the growth of a giant city (second of two volumes)]: Tokyo, Sōshisha, 96 p. [in Japanese]. {61}
- Naitō [Naitō], A., and Hozumi, K., 2003, Edo, the city that became Tokyo: Tokyo, Kodansha, 211 p. [an English combination of the two volumes from 1982; Horton, H.M., translator]. {61, 72, 76}
- Nakaminato Shishi Hensan I'inkai [Nakaminato City-History Compilation Committee], 1993, Nakaminato-shi shiryō dai 14 shū (kinsei hasen hen) [Materials about the history of Nakaminato city, v. 14 (early modern shipwrecks)]: Nakaminato-shi, 366 p. [in Japanese]. {66, 68, 71}
- Nakamura, K., and Watanabe, H., 1961, Tsunami forerunner observed in case of the Chile tsunami of 1960, in Report on the Chilean tsunami of May 24, 1960, as observed along the coast of Japan: Tokyo, Maruzen Co., Ltd., p. 82-99. {46}
- Nelson, A.N., and Haig, J.H., 1997, The new Nelson; Japanese-English character dictionary, revised edition: Rutland, Vermont, and Tokyo, Charles E. Tuttle, 1,600 p. {v, 29, 43}

- Nelson, A.R., Atwater, B.F., Bobrowsky, P.T., Bradley, L.-A., Clague, J.J., Carver, G.A., Darienzo, M.E., Grant, W.C., Krueger, H.W., Sparks, R., Stafford, T.W., and Stuiver, M., 1995, Radiocarbon evidence for extensive plate-boundary rupture about 300 years ago at the Cascadia subduction zone: *Nature*, v. 378, p. 371-374. {21, 25}
- Nelson, A.R., Johnson, S.Y., Kelsey, H.M., Wells, R.E., Sherrod, B.L., Pezzopane, S.K., Bradley, L.-A., Koehler, R.D., III, and Bucknam, R.C., 2003, Late Holocene earthquakes on the Toe Jam Hill Fault, Seattle fault zone, Bainbridge Island, Washington: *Geological Society of America Bulletin*, v. 115, p. 1388-1403, doi: 10.1130/B25262.1. {104}
- Nelson, A.R., Asquith, A.C., and Grant, W.C., 2004, Great earthquakes and tsunamis of the past 2000 years at the Salmon River estuary, central Oregon coast, USA: *Bulletin of the Seismological Society of America*, v. 94, p. 1276-1292. {16}
- Nihon Koten Bungaku Daijiten Henshū I'inkai, editor, 1983, *Nihon koten bungaku daijiten, jyōkan* [Encyclopedia of Japanese classical literature, v. 1]: Tokyo, Iwanami Shoten, 694 p. {29}
- Ninomiya, S., 1960, Tsunami in Tōhoku coast induced by earthquake in Chile; a chronological review: *Tohoku Kenkyū* [Tōhoku Kenkyū; Tōhoku Research], v. 10, no. 6, p. 19-23 [in Japanese with English summary]. {54, 59}
- Nishiyama, M., 1997, *Edo culture: daily life and diversions in urban Japan, 1600-1868*, translated and edited by Gerald Groemer: Honolulu, University of Hawai'i Press, 309 p. {63}
- O**
- Obermeier, S.F., and Dickenson, S.E., 2000, Liquefaction evidence for the strength of ground motions resulting from late Holocene Cascadia subduction earthquakes, with emphasis on the event of 1700 A.D.: *Bulletin of the Seismological Society of America*, v. 90, p. 876-896. {22, 23}
- Ōfunato Shiritsu Hakubutsukan [Ōfunato City Museum], editor and publisher, 1990, *Sanriku-engan jishin tsunami nenpyō — Tōhoku-chiho taiheiyo-gawa ni okeru rekishi-jishin, rekishi-tsunami* [Chronology of earthquakes and tsunamis on the Sanriku coast — historical earthquakes and tsunamis on Pacific Ocean shores of Tōhoku], 132 p. [in Japanese]. {44, 54}
- Ōfunato Shishi Henshū I'inkai [Ōfunato City History Publication Committee], 1978, *Ōfunato-shishi dai 3 kan 1 shiryō hen* [History of Ōfunato city, volume 3, part 1]: Ōfunato city, 631 p. [in Japanese]. {81}
- Omote, S., and Komaki, S., 1961, Ōtsuchi, Yoshihama kan [Between Ōtsuchi and Yoshihama], in *Report on the Chilean tsunami of May 24, 1960, as observed along the coast of Japan*: Tokyo, Maruzen Co., Ltd., 1961, p. 263-272 [in Japanese]. {65}
- Onuki, Y., Shibata, T., and Mii, H., 1961, *Tarō - Kamaishi chiku* [Region between Tarō and Kamaishi] in *Kon'no, E., editor, Geological observations of the Sanriku coastal region damaged by tsunami due to the Chile earthquake in 1960: Contributions to the Institute of Geology and Paleontology of Tohoku University*, v. 52, p. 3-27 [in Japanese with English abstract, figures, and tables]. {19}
- Oppenheimer, D.H., Beroza, G.C., Carver, G.A., Dengler, L., Eaton, J.P., Gee, L., Gonzalez, F.I., Jayko, A.S., Li, W.H., Lisowski, M., Magee, M.E., Marshall, G.A., Murray, M.H., McPherson, R., Romanowicz, B., Satake, K., Simpson, R.W., Somerville, P.G., Stein, R.S., and Valentine, D., 1993, The Cape Mendocino, California, earthquakes of April 1992—subduction at the triple junction: *Science*, v. 261, p. 433-438. {18}
- Oregon Sea Grant and Oregon State Marine Board, 1999, *Boating in Oregon coastal waters: Corvallis and Salem*, Oregon Sea Grant and Oregon State Marine Board, 48 p. {73}
- Oreskes, N., with Le Grand, H., editors, 2003, *Plate tectonics; an insider's history of the modern theory of the Earth*: Boulder, Colorado, Westview Press, 424 p. {8}
- Ota, Y., and Omura, A., 1991, Late Quaternary shorelines in the Japanese Islands: *Daiyonki Kenkyū* (The Quaternary Research), v. 30, p. 175-186. {65}
- Ōtsuchi-chō Kyōiku I'inkai [Ōtsuchi Town Board of Education], editor, 1961, *Chiri jishin tsunami shi* [Report on the tsunami from the Chilean earthquake]: Ōtsuchi-chō [Ōtsuchi town], 158 p. [in Japanese]. {65}
- Ōuchi, C., editor, 1943, *Mito ryōnai de nanpasen* [Shipwrecks in the territory of Mito-han]: Mito, Ibaraki-ken Suisan-kai [Ibaraki Prefecture Fishery Association], v. 2 of *Ibaraki-ken suisan-shi* [History of the fishing industry in Ibaraki prefecture], 553 p. [in Japanese]. {62}
- Ovenshine, A.T., Lawson, D.E., and Bartsch-Winkler, S.R., 1976, The Placer River Silt—an intertidal deposit caused by the 1964 Alaska earthquake: *Journal of Research of the U.S. Geological Survey*, v. 4, p. 151-162. {14}
- Owen, G., 1987, Deformation processes in unconsolidated sands, in Jones, M.E., and Preston, R.M.F., editors, *Deformation in sediments and sedimentary rocks*: Oxford, Blackwell, Geological Society Special Publication 29, p. 11-24. {23}
- Ozawa, S., Hashimoto, M., and Tada, T., 1997, Vertical crustal movements in the coastal areas of Japan estimated from tidal observations: *Bulletin of the Geographical Survey Institute*, v. 43, p. 1-21. {65, 91}
- P**
- Pararas-Carayannis, G., and Calebaugh, J.P., 1977, *Catalog of tsunamis in Hawaii*: National Oceanic and Atmospheric Administration, World Data Center A for Solid Earth Geophysics, Report SE-4, 78 p. {54}
- Parise, F., editor, 1982, *The book of calendars*: New York, Facts on File, 387 p. [reprinted in 2002 as "The book of calendars; conversion tables for ancient, African, Near Eastern, Indian, Asian, Central American and Western Calendars," by Gorgias Press, Piscataway, New Jersey, 387 p.] {43}
- Parsons, T., Tréhu, A.M., Leutgert, J.H., Miller, K., Kilbride, F., Wells, R.E., Fisher, M.A., Flueh, E., ten Brink, U.S., and Christensen, N.I., 1998, A new view into the Cascadia subduction zone and volcanic arc: implications for earthquake hazards along the Washington margin: *Geology*, v. 26, p. 199-202. {104}
- Pascoe, L.C., 1991, *Encyclopaedia of dates and events*, 3rd edition: London, Hodden and Stoughton, 827 p. {5}



The headman torches his harvested rice. Villagers rush uphill to fight the blaze. Awaiting stragglers, he says, "Let it burn!"

- Peters, R., Jaffe, B., Gelfenbaum, G., and Peterson, C., 2003, Cascadia tsunami deposit database: U.S. Geological Survey Open-file Report 03-13, 24 p. [<http://geopubs.wr.usgs.gov/open-file/of03-13/>]. {18}
- Peterson, C.D., 1997, Coseismic paleoliquefaction evidence in the central Cascadia margin, USA: *Oregon Geology*, v. 59, p. 51-74. {22}
- Peterson, M.D., Cramer, C.H., and Frankel, A.D., 2002, Simulations of seismic hazard for the Pacific Northwest of the United States from earthquakes associated with the Cascadia subduction zone: *Pure and Applied Geophysics*, v. 159, p. 2147-2168. {101, 105}
- Plafker, G., 1969, Tectonics of the March 27, 1964 Alaska earthquake: U.S. Geological Survey Professional Paper 543-I, 74 p. {9, 14}
- Plafker, G., and Savage, J.C., 1970, Mechanism of the Chilean earthquakes of May 21 and 22, 1960: *Geological Society of America Bulletin*, v. 81, p. 1001-1030. {11, 19}
- Plafker, G., Lajoie, K.R., and Rubin, M., 1992, Determining recurrence intervals of great subduction earthquakes in southern Alaska using radiocarbon dating, *in* Taylor, R.E., Long, A., and Kra, R.S., editors, *Radiocarbon after four decades; an interdisciplinary perspective*: New York, Springer-Verlag, p. 436-453. {95}
- Portinaro, P., and Knirsch, F., 1987, The cartography of North America: New York, Facts on File, 319 p. {5}
- Pratt, T.L., Brocher, T.M., Weaver, C.S., Creager, K.C., Snelson, C.M., Crosson, R.S., Miller, K.C., and Tréhu, A.M., 2003, Amplification of seismic waves by the Seattle basin, Washington State: *Bulletin of the Seismological Society of America*, v. 93, p. 533-545. {104}
- Priest, G.R., Myers, E.[P., III], Baptista, A.[M.], Kamphaus, R., and Peterson, C.D., 1997, Tsunami hazard map of the Yaquina Bay area, Lincoln County, Oregon: Oregon Department of Geology and Mineral Industries Interpretive Map Series IMS-2, scale 1:12,000. {103}
- Priest, G.R., Myers, E.[P., III], Baptista, A.[M.], Kamphaus, R.A., Fiedorowicz, B.K., Peterson, C.D., and Horning, T.S., 1998, Tsunami hazard map of the Seaside-Gearhart area, Clatsop County, Oregon: Oregon Department of Geology and Mineral Industries Interpretive Map Series IMS-3, scale 1:12,000. {103}
- Priest, G.R., Myers, E.[P., III], Baptista, A.[M.], Erdakos, G., and Kamphaus, R., 1999a, Tsunami hazard map of the Astoria area, Clatsop County, Oregon: Oregon Department of Geology and Mineral Industries Interpretive Map Series IMS-11, scale 1:24,000, 4 p. {103}
- Priest, G.R., Myers, E.[P., III], Baptista, A.[M.], and Kamphaus, R., 1999b, Tsunami hazard map of the Warrenton area, Clatsop County, Oregon: Oregon Department of Geology and Mineral Industries Interpretive Map Series IMS-12, 1 sheet, scale 1:24,000, with 5 p. text. {103}
- Priest, G.R., Myers, E.P., III, Baptista, A.M., Flueck, P., Wang, K., and Peterson, C.D., 2000a, Source simulation for tsunamis: lessons learned from fault rupture modeling of the Cascadia subduction zone, North America: *Science of Tsunami Hazards*, v. 18, p. 77-106 [<http://epubs.lanl.gov/5082.pdf>]. {103}
- Priest, G.R., Myers, E.[P., III], Baptista, A.[M.], and Kamphaus, R., 2000b, Tsunami hazard map of the Gold Beach area, Curry County, Oregon: Oregon Department of Geology and Mineral Industries Interpretive Map Series IMS-13, scale 1:12,000, 5 p. {103}
- Priest, G.R., Allan, J.C., Meyers, E.P., III, Baptista, A.M., and Kamphaus, R., 2002, Tsunami hazard map of the Coos Bay area, Coos County, Oregon: Oregon Department of Geology and Mineral Industries Interpretive Map Series IMS-21 [CD-ROM]. {103}
- ## R
- Raff, A.D., and Mason, R.G., 1961, Magnetic survey off the west coast of North America, 40°N to 52°N latitude: *Geological Society of America Bulletin*, v. 72, p. 1267-1270. {8}
- Riddihough, R., 1984, Recent movements of the Juan de Fuca plate system: *Journal of Geophysical Research*, v. 89, p. 6980-6994. {8}
- Rogers, G.C., 1988, An assessment of the megathrust earthquake potential of the Cascadia subduction zone: *Canadian Journal of Earth Sciences*, v. 25, p. 844-852. {8}
- Rogers, G.[C.], and Dragert, H., 2003, Episodic tremor and slip on the Cascadia subduction zone; the chatter of silent slip: *Science*, v. 300, p. 1942-1944, doi:10.1126/science.1084783. {99}
- Rogers, A.M., Walsh, T.J., Kockelman, W.J., and Priest, G.R., 1996, Earthquake hazards in the Pacific Northwest—an overview, *in* Rogers, A.M., Walsh, T.J., Kockelman, W.J., and Priest, G.R., editors, *Assessing earthquake hazards and reducing risk in the Pacific Northwest*, volume 1: U.S. Geological Survey Professional Paper 1560, p. 1-54. {8}
- ## S
- Sakudō, Y., 1990, The management practices of family business, in Nakane, C., and Ōishi, S., editors, *Tokugawa Japan, the social and economic antecedents of modern Japan* [W.B. Hauser, translator, Totman, C., editor of translation]: University of Tokyo Press, p. 147-166. {45}
- Satake, K., 2002, Edo-period seismicity along the Kuril Trench estimated from historic documents in Tohoku and Kanto regions: *Rekishi Jishin* [Historical Earthquakes], v. 18, p. 18-33 [in Japanese with English title and abstract]. {44}
- Satake, K., Okada, M., and Abe, K., 1988, Tide gauge response to tsunamis; measurements at 40 tide gauge stations in Japan: *Journal of Marine Research*, v. 46, p. 557-571. {46}
- Satake, K., Shimazaki, K., Tsuji, Y., and Ueda, K., 1996, Time and size of a giant earthquake in Cascadia inferred from Japanese tsunami record of January 1700: *Nature*, v. 379, p. 246-249. {43, 80, 94}
- Satake, K., Wang, K., and Atwater, B.F., 2003, Fault slip and seismic moment of the 1700 Cascadia earthquake inferred from Japanese tsunami descriptions: *Journal of Geophysical Research*, v. 108, 2325, doi: 10.1019/2003JB002521. {37, 43, 48, 75, 98}
- Satō, T., 1988, Nakamura-han, *in* Kimura, M., Fujino, T., and Murakami, T., editors, *Han-shi daijiten dai 1-kan, Hokkaido, Tōhoku hen* [Encyclopedia of the history of ruling clans and their Edo-period domains, v. 1, Hokkaido and Tōhoku]: Tokyo, Yūzan Kaku, p. 157-169 [in Japanese]. {69}
- Savage, J.C., and Thatcher, W., 1992, Interseismic deformation at the Nankai trough, Japan, subduction zone: *Journal of Geophysical Research*, v. 97, p. 11,117-11,135. {91}
- Sawai, Y., Satake, K., Kamataki, T., Nasu, H., Shishikura, M., Atwater, B.F., Horton, B.P., Kelsey, H.M., Nagumo, T., and Yamaguchi, M., 2004, Transient uplift after a 17th-century earthquake along the Kuril subduction zone: *Science*, v. 306, p. 1918-1920, doi:10.1126/science.306.5703.1857c. {65}

- Scawthorn, C., and Celebi, M., 1987, Performance characteristics of structures, 1985 Mexico City earthquake, in Cassara, M.A., and Martinez Romero, E., editors, *The Mexico earthquakes—1985: factors involved and lessons learned*: American Society of Civil Engineers, Proceedings of the international conference sponsored by the Mexican section, ASCE, September 19-21, 1986, p. 216-232. {104}
- Schweingruber, F.H., 1988, *Tree rings; basics and applications of dendrochronology*: Dordrecht, D. Reidel, 276 p. {97}
- Seeley, C., 2000, *A history of writing in Japan*: Honolulu, University of Hawai'i Press, 243 p. {40, 63, 100}
- Shennan, I., Long, A.J., Rutherford, M.M., Green, F.M., Innes, J.B., Lloyd, J.M., Zong, Y., and Walker, K.J., 1996, Tidal marsh stratigraphy, sea-level change and large earthquakes; a 5000 year record in Washington, U.S.A.: *Quaternary Science Reviews*, v. 15, p. 1-37. {100}
- Sherrod, B.L., Brocher, T.M., Weaver, C.S., Bucknam, R.C., Blakely, R.J., Kelsey, H.M., Nelson, A.R., and Haugerud, R., 2004, Holocene fault scarps near Tacoma, Washington, USA: *Geology*, v. 32, p. 9-12, doi:10.1130/G19914.1. {104}
- Shimizu, I., 1996, Bōsai kyōiku to “Inamura no hi” [Teaching emergency preparedness and “The rice-sheaf fire”]: *Rekishu Jishin [Historical Earthquakes]*, v. 12, p. 215-221 [in Japanese]. {47}
- Shimizu, I., 2003, Jidai o [wo] koete hikari kagayaku Hiro-mura tsunami zu “Inamura no hi” [The “Hiro-mura tsunami” painting of “Inamura no hi” shines through time]: *Yobō Jihō [Protection News, published by the General Insurance Association of Japan]*, v. 215, p. 2 [in Japanese] [http://www.sonpo.or.jp/publish/yobojihō/yj215_02.pdf]. {47}
- Shively, D.H., 1991, Popular culture, in Hall, J.W., editor, and McClain, J.L., assistant editor, *The Cambridge history of Japan* (Hall, J.W., Jansen, M.B., Kanai, M., and Twitchett, D., general editors), volume 4, early modern Japan: Cambridge, U.K., Cambridge University Press, p. 706-770. {63}
- Sievers C., H.A., Villegas C., G., and Barros, G., 1963, The seismic sea wave of 22 May 1960 along the Chilean coast: *Bulletin of the Seismological Society of America*, v. 53, p. 1125-1190. {19}
- Steel, D., 2000, *Marking time; the epic quest to invent the perfect calendar*: New York, J. Wiley, 422 p. {43}
- Stokes, M.A., and Smiley, T.L., 1968, *An introduction to tree-ring dating*: Chicago, University of Chicago Press (reprinted in 1996 by University of Arizona Press, Tucson), 73 p. {97}
- Stuiver, M., Braziunas, T.F., Becker, B., and Kromer, B., 1991, Climatic, solar, oceanic, and geomagnetic influences on late-glacial and Holocene atmospheric ¹⁴C/¹²C change: *Quaternary Research*, v. 35, p. 1-24. {25}
- Stuiver, M., Reimer, P.J., Bard, E., Beck, J.W., Burr, G.S., Hughen, K.A., Kromer, B., McCormac, F.G., v. d. Plicht, J., and Spurk, M., 1998, INTCAL98 Radiocarbon age calibration 24,000 - 0 cal BP: *Radiocarbon*, v. 40, p. 1041-1083. {25}
- Sullivan, W., 1991, *Continents in motion; the new Earth debate* (2nd edition): New York, American Institute of Physics, 430 p. {8}
- Swan, J.G., 1857, *The Northwest coast or, three years' residence in Washington Territory*: New York, Harper and Brothers, reprinted in 1972 by University of Washington Press, Seattle, 435 p. {12}
- Swan, J.G., 1870, *The Indians of Cape Flattery, at the entrance to the Strait of Fuca, Washington Territory*: Washington, D.C., Smithsonian Contributions to Knowledge v. 16, 108 p. {12}
- Swan, J.G., 1971, *Almost out of the world; scenes from Washington Territory*: Tacoma, Washington State Historical Society, 126 p. [newspaper articles by James G. Swan from the years 1859-1861, selected and edited by W.A. Katz]. {12}
- Szeliga, W., Melbourne, T.I., Miller, M.M., and Santillan, V.M., 2004, Southern Cascadia episodic slow earthquakes: *Geophysical Research Letters*, v. 31, L16602, doi:10.1029/2004GL020824. {99}

T

- Takada, K., and Atwater, B.F., 2004, Evidence for liquefaction identified in peeled slices of Holocene deposits along the lower Columbia River, Washington: *Bulletin of the Seismological Society of America*, v. 94, p. 550-575. {23}
- Takahashi, R., and Hatori, T., 1961, A summary report on the Chilean tsunami of 1960, in *The Committee for Field Investigation of the Chilean Tsunami of 1960, Report on the Chilean tsunami of May 24, 1960, as observed along the coast of Japan*: Tokyo, Maruzen Co., Ltd., p. 23-34. {54}
- Takeuchi, R., editor, 1985a, *Kadokawa Nihon chimei daijiten [Kadokawa's place names of Japan]*, v. 3, Iwate-ken [Iwate prefecture]: Tokyo, Kadokawa Shozen, 1282 p. [in Japanese]. {36, 51, 58}
- Takeuchi, R., editor, 1985b, *Kadokawa Nihon chimei daijiten [Kadokawa's place names of Japan]*, v. 30, Wakayama-ken [Wakayama prefecture]: Tokyo, Kadokawa Shozen, 1489 p. [in Japanese]. {85}
- Tanabe-shi Kyōiku I'inkai [Tanabe City Board of Education], editor, 1987-1991, *Kishū Tanabe-machi daichō*: Osaka, Seibundō Shuppan, 22 volumes [in Japanese]. {84}
- Teramoto, T., Nagata, Y., Sudō, H., and Manabu, T., 1961, Miura-hantō, Hamamatsu kan [Between Miura Peninsula and Hamamatsu], in *The Committee for Field Investigation of the Chilean Tsunami of 1960, Report on the Chilean tsunami of May 24, 1960, as observed along the coast of Japan*: Tokyo, Maruzen Co., Ltd., p. 321-325 [in Japanese]. {82}
- Thatcher, W., 1984, The earthquake deformation cycle at the Nankai Trough, southwest Japan: *Journal of Geophysical Research*, v. 89, p. 3087-3101. {91}

TEXTBOOK on page 113, “Shōgaku kokugo tokuhon” [“Elementary Japanese-language textbook”], was published by Japan's education ministry, Mombushō, as the fifth volume of a 12-volume set for primary grades. The copy is a reprint from 1971 in the collection of a grade school in Hirogawa, Hiro Shōgakkō. Courtesy of Ikuta Shunji, principal.

VIDEO FRAMES from “Inamura no hi” [“The rice-sheaf fire”], courtesy of Gakken Co., Tokyo.



When the tsunami comes ashore, every villager is standing safely on high ground.

- Theberge, A.E., Jr., 2003, 150 years of tides on the western coast: the longest series of tidal observations in the Americas: National Ocean Service, sesquicentennial booklet, 15 p. [http://oceanservice.noaa.gov/topics/navops/ports/150_years_of_tides.pdf]. {91}
- Toba, T., and Taka, R., 1961, Matsushima, Nakaminato kan [Between Matsushima and Nakaminato], in The Committee for Field Investigation of the Chilean Tsunami of 1960, Report on the Chilean tsunami of May 24, 1960, as observed along the coast of Japan: Tokyo, Maruzen Co., Ltd., p. 303-310 [in Japanese]. {73}
- Tokyo Daigaku Jishin Kenkyūsho [University of Tokyo, Earthquake Research Institute], editor and publisher, 1981, Shinshū Nihon jishin shiryō, dai 3 kan bekkā [Newly collected materials on historical earthquakes in Japan, volume 3, appendix], 590 p. [in Japanese]. {86, 89}
- Tokyo Daigaku Jishin Kenkyūsho [University of Tokyo, Earthquake Research Institute], editor and publisher, 1993, Shinshū Nihon jishin shiryō, zoku hoi [Newly collected materials on historical earthquakes in Japan, 2nd supplement], 1043 p. [in Japanese]. {51; fingered in photo, opposite}
- Topozada, T.R., Borchardt, G., Haydon, W., Petersen, M., Olson, R., Lagorio, H., and Anvik, T., 1995, Planning scenario in Humboldt and Del Norte Counties, California for a great earthquake on the Cascadia subduction zone: California Division of Mines and Geology Special Publication 115, 157 p. {102}
- Totman, C.D., 1967, Politics in the Tokugawa bakufu, 1600-1843: Cambridge, Harvard University Press, 346 p. {61}
- Totman, C.[D.], 1989, The green archipelago: forestry in preindustrial Japan: Berkeley, University of California Press, 297 p. {38, 72}
- Totman, C.D., 1993, Early modern Japan: Berkeley, University of California Press, 593 p. {29, 45, 63, 72}
- Trager, J., 1992, The people's chronology: New York, Henry Holt and Co., 1237 p. {87}
- Tremblay, R., 1998, Development of design spectra for long-duration ground motions from Cascadia subduction earthquakes: Canadian Journal of Civil Engineering, v. 25, p. 1078-1090. {104}
- Tsuji, Y., 1987, Tsunami-daka to higai no kankei [Relationship between tsunami height and damage]: Rekishi Jishin [Historical Earthquakes], v. 3, p. 239-256 [in Japanese]. {48}
- Tsuji, Y., and Ueda, K., 1995, Keichō 16 nen (1611), Enpō 5 nen (1677), Hōreki 12 nen (1763), Kansei 5 nen (1793), oyobi Ansei 3 nen (1856) no kaku Sanriku tsunami no kenshū [Study of the 1611, 1677, 1763, 1793, and 1856 Sanriku tsunamis]: Rekishi Jishin [Historical Earthquakes], v. 11, p. 75-106 [in Japanese]. {37, 51, 59, 64}
- Tsuji, Y., Ueda, K., and Satake, K., 1998, Japanese tsunami records from the January 1700 earthquake in the Cascadia subduction zone: Zisin [Journal of the Seismological Society of Japan], v. 51, p. 1-17 [in Japanese with English title, abstract, and captions]. {43, 48, 57, 62, 64, 72, 82, 83, 88, 90}
- Tsukahira, T., 1966, Feudal control in Tokugawa Japan: the sankin kōtai system: Cambridge, Mass., Harvard East Asia Monographs 20, 228 p. {61}
- Tsumura, K., 1991, "Inamura no hi" to Hiro-mura teibō ["Inamura no hi" and the seawall at Hiro-mura]: Jishin Journal [Earthquake Journal, published by the Association for the Development of Earthquake Prediction], v. 12, p. 22-29 [in Japanese]. {47}
- Tsunoda, R., de Bary, W.T., and Keene, D., compilers, 1964, Sources of Japanese tradition, volume 1: New York, Columbia University Press, 506 p. {63}
- Tufte, E.R., 1990, Envisioning information: Cheshire, Connecticut, Graphics Press, 126 p. {109}
- Tufte, E.R., 2001, The visual display of quantitative information (2nd edition): Cheshire, Connecticut, Graphics Press, 197 p. {109}
- ## U
- Uchida, M., 1975, Nihon rekijitsu genten [Handbook of Japanese calendars]: Tokyo, Yūzankaku Shuppan, 560 p. [in Japanese]. {43}
- Ueda, K., and Usami, T., 1990, Yushi irai no jishin kaisu no henshen [Changes in the yearly number of historical earthquakes in Japan]: Rekishi Jishin [Historical Earthquakes], v. 6, p. 181-187 [in Japanese]. {63}
- UNAM [Universidad Nacional Autónoma de México] Seismology Group, 1986, The September 1985 Michoacan earthquakes; aftershock distribution and history of rupture: Geophysical Research Letters, v. 13, p. 573-576. {9}
- Unno, K., 1994, Cartography in Japan, in Harley, J.B., and Woodward, D., editors, The history of cartography, volume two, book two, Cartography in the traditional East and East Asian societies: Chicago, University of Chicago Press, p. 346-477. {29, 32}
- Unoki, S., and Tsuchiya, M., 1961, Tarō Funakoshi kan [Between Tarō and Funakoshi], in Report on the Chilean tsunami of May 24, 1960, as observed along the coast of Japan: Tokyo, Maruzen Co., Ltd., p. 257-263 [in Japanese]. {37, 49}
- Usami, T., 1979a, Study of historical earthquakes in Japan: Bulletin of the Earthquake Research Institute, v. 54, p. 399-439. {62}
- Usami, T., 1979b, Contributors to the collection of historical data of Japanese earthquakes—Messrs. Minoru TAYAMA and Kinkichi MURASHI—: Zisin [Journal of the Seismological Society of Japan], v. 32, p. 355-359 [in Japanese]. {62}
- Usami, T., 1996, Shimpen Nihon higai jishin sōran, zōho kaitei-ban 416-1995 (Materials for a comprehensive list of destructive earthquakes in Japan, 416-1995, revised and enlarged edition): Tokyo, University of Tokyo Press, 493 p. [in Japanese]. {37, 51, 62, 91}
- ## W
- Walker, B.L. 2001, The conquest of Ainu lands; ecology and culture in Japanese expansion, 1590-1800: Berkeley, University of California Press, 332 p. {61}
- Walsh, T.J., Combellick, R.A., and Black, G.L., 1995, Liquefaction features from a subduction zone earthquake; preserved examples from the 1964 Alaska earthquake: Washington Division of Geology and Earth Resources, Report of Investigations 32, 80 p. {22}
- Walsh, T.J., Caruthers, C.G., Heintz, A.C., Myers, E.P., III, Baptista, A.M., Erdakos, G.B., and Kamphaus, R.A., 2000, Tsunami hazard map of the southern Washington coast: modeled tsunami inundation from a Cascadia subduction zone earthquake: Washington Division of Geology and Earth Resources, Geologic Map GM-49, scale 1:100,000, with 12-page pamphlet. {103}
- Walsh, T.J., Myers, E.P., III, and Baptista, A.M., 2002a, Tsunami inundation map of the Port Angeles, Washington, area: Washington Division of Geology and Earth Resources Open File Report 2002-1, scale 1:24,000.

[<http://www.dnr.wa.gov/geology/pdf/ofr02-1.pdf>]. {103}

Walsh, T.J., Myers, E.P., III, and Baptista, A.M., 2002b, Tsunami inundation map of the Port Townsend, Washington, area: Washington Division of Geology and Earth Resources Open File Report 2002-2, scale 1:24,000.
[<http://www.dnr.wa.gov/geology/pdf/ofr02-2.pdf>]. {103}

Walsh, T.J., Myers, E.P., III, and Baptista, A.M., 2003a, Tsunami inundation map of the Quileute, Washington, area: Washington Division of Geology and Earth Resources Open File Report 2003-1, 1 sheet, scale 1:24,000
[<http://www.dnr.wa.gov/geology/pdf/ofr03-1.pdf>]. {103}

Walsh, T.J., Myers, E.P., III, and Baptista, A.M., 2003b, Tsunami inundation map of the Neah Bay, Washington, area: Washington Division of Geology and Earth Resources Open File Report 2003-2, 1 sheet, scale 1:24,000
[<http://www.dnr.wa.gov/geology/pdf/ofr03-2.pdf>]. {103}

Walsh, T.J., Titov, V.V., Venturato, A.J., Mofjeld, H.O., and González, F.I., 2004, Tsunami hazard map of the Bellingham area—modeled tsunami inundation from a Cascadia subduction zone earthquake: Washington Division of Geology and Earth Resources Open File Report 2004-15, scale 1:50,000
[<http://www.dnr.wa.gov/geology/pdf/ofr04-15.pdf>]. {103}

Walter, L., 1994, Catalogue, *in* Walter, L., editor, Japan, a cartographic vision; European printed maps from the early 16th to the 19th century: Munich and New York, Prestel-Verlag, 232 p. {31}

Wang, K., Wells, R.E., Mazzotti, S., Dragert, H., Hyndman, R.D., and Sagiya, T., 2003, A revised 3-D dislocation model of interseismic deformation for the Cascadia subduction zone: *Journal of Geophysical Research*, v. 108, 2026, doi:10.1029/2001JB001227. {99}

Ward, P.L., Page, R.A., Hodgen, L.D., and Troll, J.A., 1989, The Loma Prieta earthquake of October 17, 1989; a brief geologic view of what caused the Loma Prieta earthquake and implications for future California earthquakes—what happened ... what is expected ... what can be done: U.S. Geological Survey pamphlet, 16 p. {109}

Watanabe, H., 1998, *Nihon higai tsunami sōran, dai ni-han* (Comprehensive list of destructive tsunamis to hit the Japanese islands, 2nd edition): Tokyo, University of Tokyo Press, 238 p. [in Japanese]. {54, 59, 62, 77, 85, 94}

Weischet, W., 1963, Further observations of geologic and geomorphic changes resulting from the catastrophic earthquake of May 1960, in Chile: *Bulletin of the Seismological Society of America*, v. 53, p. 1237-1258. {11}

Williams, H.F.L., Hutchinson, I., and Nelson, A.R., 2005, Multiple sources for late Holocene tsunamis at Discovery Bay, Washington State, USA: *The Holocene*, v. 15, p. 60-73, doi:10.1191/0956683605h1784rp. {18}

Williams, N., 1999, *Chronology of world history*, v. II, 1492-1775, the expanding world: Santa Barbara, Calif., ABC-CLIO, 765 p. {5}

Witter, R.C., Kelsey, H.M., and Hemphill-Haley, E., 2003, Great Cascadia earthquakes and tsunamis of the past 6700 years, Coquille River estuary, southern coastal Oregon: *Geological Society of America Bulletin*, v. 115, p. 1289-1306. {16, 101}

Wright, C., and Mella, A., 1963, Modifications to the soil pattern of south-central Chile resulting from seismic and associated phenomena during the period May to August 1960: *Bulletin of the Seismological Society of America*, v. 53, p. 1367-1402. {19}

Y

Yamaguchi, D.K., Atwater, B.F., Bunker, D.E., Benson, B.E., and Reid, M.S., 1997, Tree-ring dating the 1700 Cascadia earthquake: *Nature*, v. 389, p. 922-923, editors' correction in v. 390, p. 352. {96, 97}

Yamashita, F., 1997, *Tsunami*: Tokyo, Ayumi Shuppan, 222 p. [in Japanese]. {37, 41, 51, 59}

Yanuma, T., and Tsuji, Y., 1998, Observation of edge waves trapped on the continental shelf in the vicinity of Makurazaki Harbor, Kyushu, Japan: *Journal of Oceanography*, v. 54, p. 9-18
[<http://www.terrapub.co.jp/journals/JO/pdf/5401/54010009.pdf>] {86}

Yeats, R.S., 2004, *Living with earthquakes in the Pacific Northwest, a survivor's guide*, second edition: Corvallis, Oregon State University Press, 400 p. {104}

Yoshida, Y., and Oikawa, K., 1983-1992, *Zusetsu Morioka yonhyaku-nen* [Four hundred years of Morioka history]: Morioka, Kyodo Bunka Kenkyūkai, 3 volumes, 1,458 p. [in Japanese]. {44}

Yoshinobu, E., 1961, *Shinjō-cho ni okeru Ansei Nankai Chiri jishin ni yoru tsunami no takasa no sokutei* [Height measurements of the tsunamis in Shinjō ward caused by the Ansei, Nankai, and Chilean earthquakes]: Tanabe bunkazai [Cultural properties of Tanabe city], v. 5, p. 14-19 [in Japanese]. {85, 89}

Z

Zachariasen, J., Sieh, K., Taylor, F.W., Edwards, R.L., and Hantoro, W.S., 1999, Submergence and uplift associated with the giant 1833 Sumatran subduction earthquake: evidence from coral microatolls: *Journal of Geophysical Research*, v. 104, p. 895-919. {5}

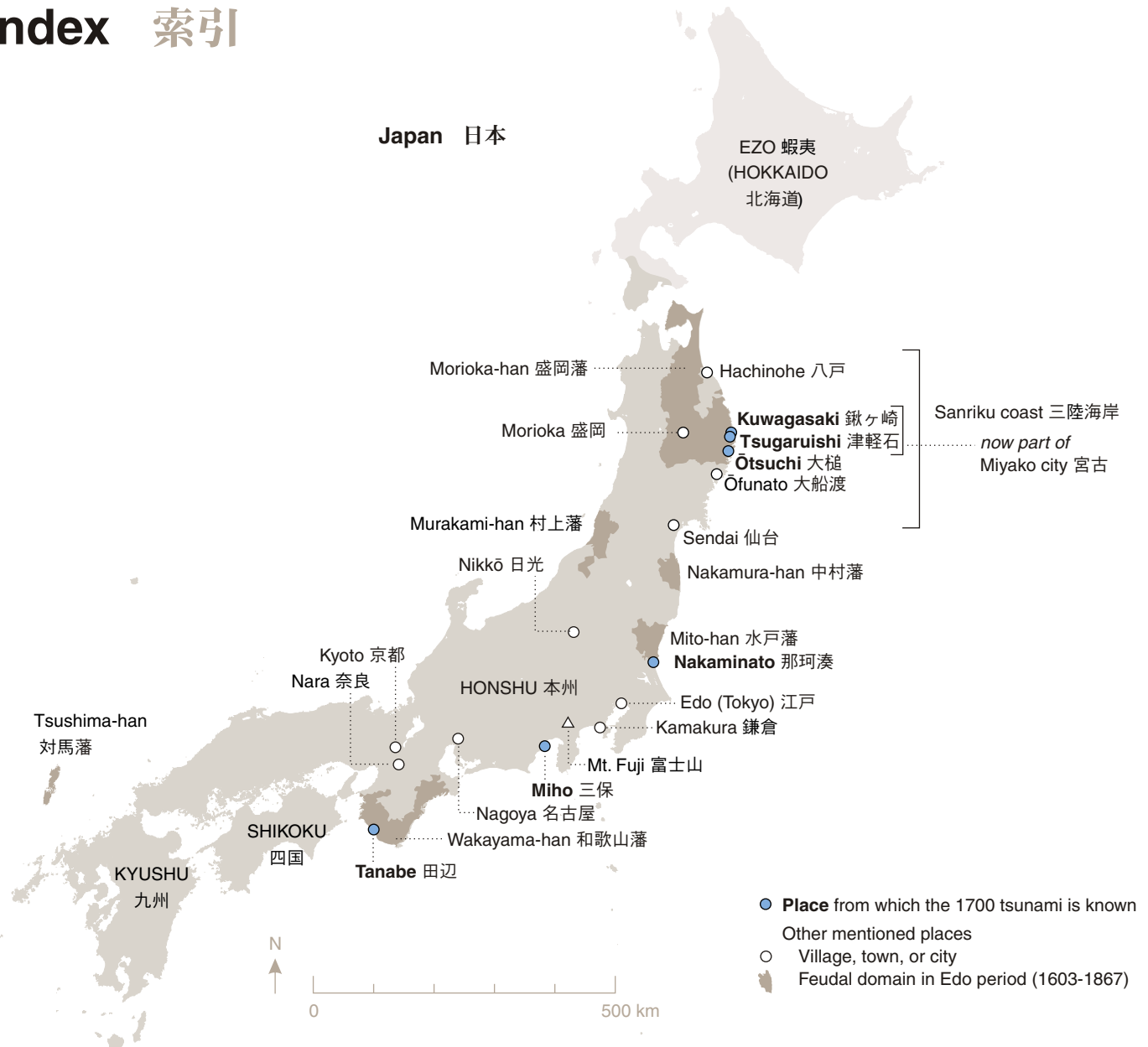
Accounts of the 1700 tsunami form part of the 21-volume, 16,812-page earthquake anthology, “*Shinshū Nihon jishin shiryō*” (p. 62). Two of the volumes are cited at the top of the facing page, under Tokyo Daigaku Jishin Kenkyūsho.



First volume, shelved at upper right, was published in 1981.

Fingered volume, published in 1993, contains accounts of the orphan tsunami of 1700.

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Courtesy of Ōfunato city