

MARIANA'S ACTIVE ARC: A BIBLIOGRAPHY

L. G. Eldredge

University of Guam Marine Laboratory

Technical Report 82

April 1983

INTRODUCTION

The Mariana Archipelago is divided into a system of two discrete arcs. The Frontal (or Outer) Arc composed of Guam, Rota, Aguijan, Tinian, Saipan and Farallon de Medinilla lies at the southern end of the Archipelago. These islands are composed primarily of raised limestone and are of a much older age than the remaining islands. The line of islands between Esmeralda Bank and Farallon de Pajaros (Uracas) constitutes the Active (or Inner) Arc. These islands are volcanic, have little or no coral reef development, and are much younger geologically. Most of them are active volcanoes.

The geology of these islands as they are related to crustal movements in the Western Pacific has been studied by Karig (1971 and in a number of other publications), Meijer (1976, 1981), Meijer and Glasley (1973), and Stern (1979, 1981). A general geological survey of Pagan was conducted by Corwin et al. (1957), of Agrihan by Stern (1978, 1979), and of Sarigan by Meijer and Reagan (1981). The geochemistry of Esmeralda Bank has been studied by Stern and Bibee (1980a, 1980b), and the activity of the same bank was studied by Gavrilenko et al. (1980) and Gavrilenko (1981). Ruby Volcano was named as a result of acoustic observations by Johnson (1973).

The first and most extensive climatic survey was that of Chief of Naval Operations (1944). A somewhat later survey included oceanographic information (CINPAC-CINCPAC, 1945). The climatic conditions at Pagan have been specifically detailed by U.S. Naval Weather Service Command (1971). The physical oceanography of the islands has been investigated by de Witt (1972). The general oceanographic conditions of the northwest Pacific Ocean near the Marianas has been reviewed by Eldredge (in press).

The biota of the islands is not well known. Maug is the only island from which a "natural history" has been published (Eldredge et al., 1977). Some information is available concerning other islands (Abbott et al. 1982). Botanical studies were originally made by Hosokawa (1934 and other papers) and Kanehira (1934 and other papers). The most extensive studies have been those of Fosberg (1958, 1960) and Fosberg et al. (1975, 1977, 1980). The majority of plants have been noted in the checklists of Fosberg et al. (1979, 1982) and Fosberg and Sachet (in press). The marine algae from most of the islands have been reported by Tsuda and Tobias (1977a, 1977b) who noted a number of rare and unusual forms.

Among the marine animals, the molluscs are the best known group (Abbott, 1939, 1960, 1961, 1968; Carlson and Hoff, 1972; Cernohorsky, 1976, Dickinson, 1976; Emerson and Cernohorsky, 1973; Houbrick, 1978; Powell, 1973; Rosewater, 1970; Vermeij et al., in press). Hermit crabs have been reported by Wooster (1979, in press), and one species of deepwater crab was reported by Eldredge (1980). Some fishes have been reported (Gawel, 1975; Jones et al., n.d.) from several islands; a detailed list has been prepared from Maug (Eldredge et al., 1977). Birds have been reported by Baker (1951) and more recently listed by Owen (1977). Falanruw (1975) recorded the megapode from all the islands. A subspecies of fruit bat has been described from Pagan (Yamashina, 1932).

Although few whales have been reported, whaling efforts have been described (Longhorn, 1979; Martin, 1979; Townsend, 1935; Ward, 1967). Numerous fishery surveys have been conducted among these northern islands (Hosmer and Kami, 1981; Japan Marine Fishery Resources Research Center, 1975, 1976, 1977; Kearney et al., 1979, 1980; Skipjack Programme, 1980, 1981). The fisheries of all the islands is reviewed by Uchida (in press).

Historically, the islands have been quite well documented from their discovery (Garcia, 1683) to the nineteenth century (Beechey, 1831; Ibanez y Garcia, 1886; Marche, 1891; Sanchez y Zayas, 1866). The memories of de la Cortes' governorship between 1855 and 1866 have been translated (Corte, 1926-27). Scientific studies to the present time have been outlined by Eldredge (in press). Little archaeological information is available. Egami and Saito (1973) described sites on Pagan, and Yawata (1940a) described sites on Alamagan.

Most of the literature of the islands of the Active Arc is of a general or popular nature. One of the earliest (Fritz, 1902) detailed an official trip among the islands and described how coconuts and other food products were planted. Prowezak (1913) described all the islands of the German Marianas. More recently, Eldredge (1975), Evans (1977), Farrell (1979), Kluge (1968), Ronck (1975a, 1975b, 1975c), Smith (1964), and White (1976) described various trips throughout the islands. Lehne and Gabler (1972) provided the most extensive information for all the islands.

Some planning efforts have been made. Johnson (1957) reviewed each island and proposed development plans. Recreation studies were conducted by H. Mogi (1977) and resort development (Towa Real Estate, Inc., 1970) and a physical development master plan for Pagan (Pacific Planning Design Consultants, 1978). Mineral resources were outlined by Dela Cruz (1971) and beach and aggregate resources at Pagan by Doan and Siegrist (1979).

Numerous investigations on individual islands have been conducted. The index cross references studies and islands.

ACKNOWLEDGEMENTS

The compiler wishes to thank the staffs of the Micronesian Area Research Center and Pacific Scientific Information Center for their assistance with the bibliography. Thanks are also given to Rufo Lujan (Chief of Fish and Wildlife) and Paul Benoit (Coastal Resources Management Office) for their helpful suggestions. Acknowledgements are extended to Office of Sea Grant Program Grant No. NA81AA-D-0070 for printing this technical report.

- Abbott, A. T., E. A. Kay, and C. H. Lamoureux. 1982. Natural landmarks survey of the islands of the Pacific. National Park Service Natural Landmarks Program, Dept. Interior. 194 p.
- Abbott, R. T. 1959. The family Vasidae in the Indo-Pacific. Indo-Pac. Moll. 1(1):15-32.
- Abbott, R. T. 1960. The genus Strombus in the Indo-Pacific. Indo-Pac. Moll. 1(2):33-144.
- Abbott, R. T. 1961. The genus Lambus in the Indo-Pacific. Indo-Pac. Moll. 1(3):147-174.
- Abbott, R. T. 1968. The helmet shells of the world (Cassidae). Part 1. Indo-Pac. Moll. 2(9):15-202.
- Anderson, D. 1950. Interim report on botanical field work in the Marianas and central Caroline Islands. Scientific Investigations in Micronesia. 11 p.
- Anon. n.d. Great, major, and destructive earthquakes in the Mariana Islands region, 1902-1974. Unpubl. U.S. Dept. Interior, Geological Survey.
- Baker, F. S. 1975. Mariana album. Mariana Education Dept., Saipan. 166 p.
- Baker, R. H. 1951. The avifauna of Micronesia, its origin, evolution, and distribution. Univ. Kansas Publ. Mus. Nat. Hist. 3(1):1-359.
- Banks, N. G. 1981. Geologic report to the Governor Commonwealth of the Mariana Islands, Pagan eruption, May 15, 1981. Unpubl. Report. 7 p. [extracted and added to in SEAN Bull. 6(5):2-5; further noted SEAN Bull. 6(6):4 and 7(11):13]
- Banks, N. G., and K. T. Honma. 1981. Deformation report to the Governor Commonwealth of the Northern Mariana Islands. Unpubl. Report. 5 p.
- Baschin, O., et al. 1927. E. vonSeydlitz'sche geographie hundertjahr. Aussereuropaische erdteile, Asien, Afrika, Australien mit Ozeanien Amerika, Polargebiete, Meere. Ferdinand Hirt, Beslau. [color watercolor figure of Pagan]
- Beechey, F. W. 1831. Narrative of a voyage to the Pacific and Beering's Strait.... London.
- Best, B. 1981. Bibliography of inland aquatic ecosystems of the Marianas Archipelago. Univ. Guam Mar. Lab. Tech. Rept. 72. 64 p.
- Best, B. R., and C. E. Davidson. 1981. Inventory and atlas of the inland aquatic ecosystems of the Marianas Archipelago. Univ. Guam Mar. Lab. Tech. Rept. 75. 226 p.

- Borrer, D. J. 1947. Birds of Agrihan. *Auk* 64:415-417.
- Bryan, E. H., Jr. 1943. Guide to Pacific islands. JICPOA Bull. 48-43, 394 p.
- Bryan, E. H., Jr. 1971. Guide to place names in the Trust Territory of the Pacific islands. Pacific Scientific Information Center, Honolulu.
- Burn, R. 1974. The taxonomy and distribution of Marianaina rosea (Pruvot-Fol, 1930) and Tecacera pacifica (Bergh, 1883) comb. nov. *Veliger* 16(3):305-306.
- Carlson, C., and P. J. Hoff. 1972. Northern Marianas opisthobranchs. Unpubl.
- Cernohorsky, W. O. 1976. The Mitridae of the world. Part I. The subfamily Mitrinae. *Indo-Pac. Moll.* 3(17):273-528.
- Chapman, P. S. 1964. Micronesian archaeology: an annotated bibliography. M.A. Thesis, Sanford Univ. 265 p.
- Chief of Naval Operations. 1944. A climatic summary of the Mariana Islands. Chief of Naval Operations, Aerology Section, Washington, D.C. 47. p.
- CINPAC-CINCPOA. 1945. Climatology and oceanography of the Western Pacific. Volume 1. Bull. 4-45:1-111.
- Commonwealth of the Northern Mariana Islands. 1980. Fisheries development plan. Commonwealth of the Northern Mariana Islands. 86 p.
- Corte, F. de la. 1926-1927. Memoirs of Don Felipe de la Corte's eleven years as governor of Guam 1855-1866. *Guam Recorder* 3:96-98; 108-109; 126-127; 138-140; 158-160; 170-174; 214-216; 226-229; 242-244; 254-257; 270-271; 282-283; 298-299; 310-313; 328-331; 344-348.
- Corwin, G. 1961. Volcanic suite of Pagan, Mariana Islands. In *Short papers in the geologic and hydrologic sciences*, Article 223. *Geol. Surv. Prof. Pap.* 424-C:204-206.
- Corwin, G., L. D. Bonham, M. J. Terman, and G. W. Viele. 1957. Military geology of Pagan, Mariana Islands. Intelligence Div., Office of the Engineer, U.S. Geological Survey. 259 p.
- Daley, D. 1976. Passage to Agrihan. *Islander*, 2 May 1976, pp. 12-13.
- Dela cruz, G. D. 1971. Micronesian minerals: an abstract of available information. Div. Lands and Surveys, Dept. Resources and Development, TTPI. 52 p.
- deWitt, P. W. 1972. Physical oceanography in the Mariana Islands area, spring and fall 1971. M.S. Thesis, University of Hawaii. 48 p.

- Dickinson, R. E. 1976. Gastropods of the northern Marianas. Unpubl. Graduate Report. 19 p.
- Dixon, T. H., and R. Batiza. 1979. Petrology and chemistry of Recent lavas in the northern Marianas; implication for the origin of island arc basalts. *Contrib. Mineral. Petrol.* 70(2):167-181.
- Doan, D. B., and H. G. Siegrist. 1979. Beaches, coastal environments, and alternative sources of fine aggregate in the Northern Mariana Islands. *Coastal Resources Management, Saipan.* 108 p.
- Egami, T., and F. Saito. 1973. Archaeological excavation on Pagan in the Mariana Islands. *J. Anthropol. Soc. Nippon* 81(3):203-236.
- Eldredge, L. G. 1975. A New World adventure. *Glimpses of Guam* 15(2):36-45.
- Eldredge, L. G. 1977. Comments on preserving uninhabited islands of the Commonwealth of the Northern Marianas.... Unpl.
- Eldredge, L. G. 1980. Two species of Homola (Dromiacea, Homolidae) from Guam. *Micronesica* 16(2):271-277.
- Eldredge, L. G. 1981. Preliminary report of environmental survey at Pagan following the eruption of Mt. Pagan. Unpubl.
- Eldredge, L. G. 1982. Impact of a volcanic eruption on an island environment. *Pacific Science Assoc. Inform. Bull.* 34(3):26-29.
- Eldredge, L. G. in press. Historical background, description of the islands, and review of the climate, oceanography, and submarine topography around Guam and the Northern Mariana Islands. *Nat. Mar. Fish. Serv., Honolulu.*
- Eldredge, L. G., R. T. Tsuda, P. Moore, M. Chernin, and S. Neudecker. 1977. A natural history of Maug, Northern Mariana Islands. *Univ. Guam Mar. Lab. Tech. Rept.* 43. 87 p.
- Elliot, H. 1973. Pacific oceanic islands recommended for designation as islands for science. pp. 287-305. *In Regional symposium on conservation of nature--reefs and lagoons. South Pacific Commission.*
- Emerson, W. K., and W. O. Cernohorsky. 1973. The genus Drupa in the Indo-Pacific. *Indo-Pac. Moll.* 3(13):1-40.
- Endo, R. 1949. A lexicon of geologic names of Rota, Guam, Pagan Islands, Mariana Island, preliminary. M.S. report.
- Esser, P. V. N. 1982. Northern Marianas. *Pacific Mag.* 7(4):29-32.
- Evans, P. J. 1977. Intriguing past, intriguing present, intriguing future. *Islander* 28 August 1977, pp. 8-13.

- Falanruw, M. V. C. 1975. Distribution of the Micronesian megapode Megapodius Paperouse in the Northern Mariana Islands. *Micronesica* 11(1):149-150.
- Farrell, D. 1979. Northern Marianas. Mine eyes have seen the glory. *Glimpses* 19(4):18-31.
- Farrell, D. 1980. Pagan: paradise or paradox? *Islander*, 3 February 1980.
- Fosberg, F. R. 1958. Vascular flora of Pagan Island, Northern Marianas. *Pac. Sci.* 12(1):17-20.
- Fosberg, F. R. 1960. The vegetation of Micronesia, 1. General descriptions, the vegetation of the Mariana Islands, and a detailed consideration of the vegetation of Guam. *Bull. Am. Mus. Nat. Hist.* 119(1):1-75.
- Fosberg, F. R., and G. Corwin. 1958. A fossil flora from Pagan, Mariana Islands. *Pac. Sci.* 12(1):3-16.
- Fosberg, F. R., M. V. C. Falanruw, and M.-H. Sachet. 1975. Vascular flora of the Northern Mariana Islands. *Smithsonian Contrib. Bot.* 22:1-44.
- Fosberg, F. R., M. V. C. Falanruw, and M.-H. Sachet. 1977. Additional records of vascular plants from the Northern Mariana Islands. *Micronesica* 13(1):27-31.
- Fosberg, F. R., M. V. C. Falanruw, and M.-H. Sachet. 1980. Additional records of vascular plants from the Northern Mariana Islands. 2. *Micronesica* 16(2):211-214.
- Fosberg, F. R., M.-H. Sachet, and R. Oliver. 1979. A geographical checklist of the Micronesian Dicotyledonae. *Micronesica* 15(1-2):41-295.
- Fosberg, F. R., M.-H. Sachet, and R. Oliver. 1982. Geographical checklist of the Micronesian Pteridophyta and Gymnospermae. *Micronesica* 18(1):23-82.
- Fosberg, F. R., and M.-H. Sachet. in press. Micronesian Poaceae: critical and distributional notes. *Micronesica* 18(2).
- Fritz, G. 1902. Reise nach dem nordlichen Marianen. *Mitt. Deutsch. Schutzgeb.* Sudsee 15:96-118.
- Fukami, T., and W. Cross. 1969. The lost men of Anatahan. Paperback Library, N.Y. 144 p.
- García, F. 1683. Vida y martirio de el Venerable Padre Luis de Sanvitores de la compania de Jesus, Primer Apostol de las Islas Marianas.

- Gavrilenko, G. M. 1981. The submarine Esmeralda volcano and related ferro-manganese ore formation. *Vulkanol. Seismol.* 1981(1):51-55. [in Russian]
- Gravilenko, G. M., A. P. Gorshkov, and K. A. Skripko. 1980. Intensification of gas and hydrothermal activity of the Esmeralda submarine volcano in January 1978 and its influence on the chemical composition of sea water. *Vulkanol. Seismol.* 1980(2):19-29. [in Russian]
- Gawel, M. J. 1975. Fishes of the Northern Marianas. Unpubl. Graduate Report. 10 p.
- Gilbert, W. J. 1978. *Rhipilia sinuosa* sp. nov. (Chlorophyta, Siphonales) from Micronesia. *Phycologia* 17(3):311-313.
- Hartert, E. 1898. On the birds of the Marianne Islands. *Nov. Zool.* 5(1):51-69.
- Hasegawa, K. 1917. Eruption that occurred near Agrihan Island. *J. Meteorol. Soc. Japan, Ser. 1*, 36(7):319-320.
- Hastings, B. 1982. Marianas volcano suspected as a cause of huge dust cloud. *Honolulu Advertiser*, 10 March 1982.
- Hatanaka, S. 1979. A bibliography of Micronesia compiled from Japanese publications 1915-1945. *Occas. Pap. Res. Inst. Oriental Cultures Gakushuin Univ.* 8:1-217.
- Hosmer, A., and H. Kami. 1981. PTDf Seamount groundfish development project--Guam. May 1980-January 1981. *FV Typhoon. Aquatic Wildlife Resources, Guam.* 25 p.
- Hosokawa, T. 1934a. On the mokumao in the Marianas. *Kudoa* 2(2):107-113.
- Hosokawa, T. 1934b. Preliminary account of the vegetation of the Marianne Islands group. *Bull. Biogeog. Soc. Japan* 5:124-172.
- Houbrick, R. S. 1978. The family Cerithiidae in the Indo-Pacific. Part 1: The genera *Rhinoclavis*, *Pseudovertagus* and *Clavocerithium*. *Monogr. Mar. Moll.* 1:1-130.
- Ikeguchi, R., and P. Castro. 1975. Project of Pagan Island development.
- Ibanez y Garcia, L. 1886. *Historia de las Islas Marianas, y las Carolinas y Palao....* Grenada. 207 p.
- Inoyama, T. 1935. Geomorphology of the main islands in the South Seas. *Globe* 23(6):39-59. [in Japanese]
- Itono, H. 1980. The genus *Galaxaura* in Micronesia. *Micronesica* 16(1):1-19.

- Japan Marine Fishery Resource Research Center. 1975. Report of feasibility study on skipjack pole-and-line fisheries in the Micronesian waters. Japan Marine Fishery Resource Center. 134 p.
- Japan Marine Fishery Resource Research Center. 1976. Report of feasibility study on skipjack pole-and-line fisheries in the Micronesian waters. Japan Marine Fishery Resource Center. 190 p.
- Japan Marine Fishery Resource Research Center. 1977. Report of feasibility study on skipjack pole-and-line fisheries in the Micronesian waters. JAMARC Rept. 5. 193 p.
- Johnson, J. B. 1957. Survey report of the islands north of Saipan. U.S. Naval Administration Unit, Saipan. 58 p.
- Johnson, R. H. 1973. Acoustic observations on nonexplosive submarine volcanism. J. Geophys. Res. 78(26):6093-6096. [discovery and naming of Ruby Volcano]
- Joint Intelligence Center, Pacific Ocean Areas. 1944a. Pagan and minor Marianas. Air Target Maps and Photos ATF No. 42-A.
- Joint Intelligence Center, Pacific Ocean Areas. 1944b. Marianas. Information Bulletin. JICPOA Bull. 7-44. 80 p.
- Jones, R. S., H. T. Kami, and H. K. Larson. n.d. Northern Marianas fishes. Unpubl.
- Jouanin, C. 1959. Une colonie meconnue d'albatros a pieds noirs, Diomedea nigripes, dans les Iles Mariannes. Bull. Mus. Nat. Hist. Nat., Ser. 2, 31(6):477-480.
- Kaiser, E. 1907. Beitrage zur Petrographie und Geologie der Deutschen Sudsee-Inseln. Jahrb. Konig. Preuss. Geolog. Landes. Bergak. Berlin 24:91-121.
- Karig, D. E. 1971. Structural history of the Mariana Islands arc system. Bull. Geol. Soc. Am. 82:323-344. [several other general papers]
- Kanamaru, T. 1936-1937. Voyage to the southward of Uracas. Mie Kyoiku koron 62, 63, 65. [in Japanese]
- Kanehira, R. 1934. A botanical excursion to the Northern Marianas. Bot. Zool. 2(5):913-922. [in Japanese]
- Kearney, R. E., R. D. Gillett, and D. Whyman. 1979. Interim report of the skipjack survey and assessment programme in the waters of the Trust Territory of the Pacific Islands and Guam. Skipjack Survey and Assessment Programme, Preliminary Country Report No. 12. 14 p.

- Kearney, R. E. and J. P. Hallier. 1980. Second interim report of the activities of the skipjack survey and assessment programme in the waters of the Trust Territory of the Pacific Islands. Skipjack Survey and Assessment Programme, Preliminary Country Report No. 19. 14 p.
- Keating, B., C. E. Helsley, K. Kodama, and S. Uyeda. 1981. Paleomagnetism of the Mariana Island Arc. Internat. Assoc. Volcanol. Chem. Earth's Interior, Tokyo-Hakone, p. 24. [abstract]
- Kiener, R. 1977. Of fires & files. Glimpses 17(3):46-50.
- King, W. B. 1967. Preliminary Smithsonian identification manual. Seabirds of the tropical Pacific Ocean. Smithsonian Institution, Washington, D.C. 126 p.
- Kluge, P. F. 1968. Field trip. Micronesian Reporter 14(1):8-13.
- Kluge, P. F. 1980. Importing the American dream. Geo. 2(3):136-156.
- Koert, W., and L. Finckh. 1920. Zur geologischen Kenntnis von den Palau-Inseln, Jap, den Marianen und Ponape. Beit. Geol. Erforsch. Deutschen Schutz. 18:1-15.
- Kondo, Y. 1950. The giant African snail (*Achatina fulica*) in Palau (in part), Pagan, and Guam. Invert. Consult. Comm. Pacific, Pacific Science Board. 13 p.
- Kondo, Y. 1970. Some aspects of Mariana Island Partulidae (Mollusca, Pulmonata). Occas. Pap. B.P. Bishop Mus. 24(5):73-90.
- Koyanagi, R. Y., K. T. Honma. 1981. Seismic report to the governor Commonwealth of the Northern Mariana Islands. North Pagan Volcano, 1981. Unpubl. Report. 2 p.
- Kuno, H. 1962. Catalogue of the active volcanoes of the world including solfataras fields. Part XI. Japan, Taiwan and Marianas. Internat. Volcanol. Assoc. 332 p.
- Langdon, R. 1979. Thar she went: an interim index to the Pacific ports and islands visited by American whalers and traders in the 19th century being a supplement to "American whalers and traders in the Pacific: a guide to records on microfilm." Pacific Manuscripts Bureau, Research School of Pacific Studies, Australian National University, Canberra.
- Larson, E. E., and others. 1974. Major-element petrochemistry of some extrusive rocks from the volcanically active Mariana Islands. Bull. Volcanol. 38(2):361-377.
- LeGobien, C. 1701. Histoire des Isles Marianas. Paris.

- Lehne, R. H., and C. Gabler. 1972. *Über die Marianen*. Wohldorf, West Germany. 47 p.
- La Perouse, J. F. 1797. *Voyage de La Perouse autour du monde...* Paris.
- Lindblad Explorer. 1976. Report to the Resident Commissioner in Saipan. Unpubl.
- Lindblad Explorer. 1977. Report to the Resident Commissioner in Saipan. Unpubl.
- Link, D. K. 1982. Pagan resettlement uncertain. *Glimpses* 22(1):24-25.
- Marche, A. 1890. *Mon voyage aux îles Mariannes*. Bull. Soc. Geogr. Marseille 14:22-30.
- Marche, A. 1891. *Rapport general sur une mission aux îles Mariannes*. *Nouv. Arch. Miss. Scientif. Litt., N. Ser.*, 1:241-280. [translation, 1982, The Mariana Islands, Micronesian Area Research Center, 52 p. with first-time printed original Marche photographs of islands]
- Martin, K. R. 1979. American whaleships in the Mariana Islands. *Guam Recorder*, Ser. 2, 9:3-9.
- Maruyama, M. 1954. *Anatahan*. Hermitage House, N.Y. 206 p.
- Maso, M. S. 1902. Brief notes concerning the volcanoes and seismic phenomena of the Mariana Islands. *Bull. Manila Cent. Observat.* 1902:205-212, 226-234.
- Meijer, A. 1976. Pb and Sr isotopic data bearing on the origin of volcanic rocks from the Mariana island-arc system. *Bull. Geol. Soc. Am.* 87:1358-1369.
- Meijer, A. 1981. Regional distribution and character of active andesite volcanism (f) Mariana-volcano islands. In R. S. Thorpe (ed.) *Orogenic andesites and related rocks*. Wiley and Sons, N.Y.
- Meijer, A., E. Anthony, and M. Reagan. 1981. Petrology of volcanic rocks from the fore-arc sites. In D. Hussong et al. (eds.) *Initial reports of the Deep Sea Drilling Project 60*.
- Meijer, A., and W. E. Glasley. 1973. A survey of trace element abundances in volcanic rocks from the Mariana Island Arc. *EOS* 54(11):1218. [abstract]
- Meijer, A., and M. Reagan. 1981. Petrology and geochemistry of the island of Sarigan in the Mariana Arc; calc-alkaline volcanism in an oceanic setting. *Contrib. Mineral. Petrol.* 77(4):337-354.

- Meinicke, C. E. 1875. Die Inseln des Stillen Ozeans, eine geographische Monographie. Vol. II. Polynesien und Mikronesien. Verlag von Paul Froberg, Leipzig. 487 p.
- Micronesian Coordinated Development Co., Ltd. 1976. Survey report and around the Marianas and fisheries situation in Saipan, Tinian, and Rota Islands. Fishing method: Bottom handline. Unpubl. Report. 24 p.
- H. Mogi-Planning and Research, Inc. 1977. Northern Mariana Islands park and outdoor recreation resource study. Northern Mariana Islands Planning Office. 287 p.
- Naval Intelligence Division. 1945. Pacific islands, Vol. 1. Royal Naval Intelligence Division, London [pp. 432-445-Marianas].
- Nishiyama, S. 1942. On the recent shallow-water echnoids from the South Sea Islands. J. Japan. Oceanogr. Soc. 1(1-2):15-24. [in Japanese]
- Ohashi, K. 1917. A brief history of the Mariana Islands. J. South Sea Assoc. 3(1):53-59. [in Japanese]
- Owen, R. P. 1977. A checklist of the birds of Micronesia. Micronesica 13(1):65-81.
- Pacific Planning and Design Consultants. 1978. Physical development master plan of the Commonwealth of the Northern Mariana Islands. Volume V. Pagan. Office of Transition Studies and Planning, Government of the Northern Mariana Islands. 59 p.
- Pangelinan, J. B., and R. I. Kapileo. 1970. Pagan Island land use proposals. Dept. Resources and Development, TTPI. 27 p.
- Phillips, B. 1981. Mt. Pagan blows its top. Glimpses 21(4):10-27.
- Polovina, J. J., and R. C. Roush. 1982. Chartlets of selected fishing banks and pinnacles in the Mariana Archipelago. Nat. Mar. Fish. Serv., Honolulu, Admin. Rept. 4-82-19. 15 p.
- Polovina, J. J., and N. T. Shippen. 1983. Estimates of the catch and effort by Japanese longliners and baitboats in the fishery conservation zone around the Mariana Archipelago. Nat. Mar. Fish. Serv., Honolulu, Admin. Rept. H-83-1. 42 p.
- Powell, A. W. B. 1973. The patellid limpets of the world (Patellidae). Indo-Pac. Moll. 3(15):75-200.
- Prowazek, S. J. 1913. Die deutschen Marianen ihre natur und geschichte. Leipzig. 125 p.

- Quinn, S. S. 1978. The Northern Mariana Islands. An annotated bibliography of selected works. Bureau of Education, Library Services, TTPI. 175 p.
- Ronck, R. 1975a. Islands for science. The Sunday News Magazine, 27 July 1975, pp. A1-A7.
- Ronck, R. 1975b. New World in the Marianas. Oceans 8(6):6-9.
- Ronck, R. 1975c. Sailing "a natural laboratory." Pacific Daily News, 29 Jan. 1975, p. 22.
- Rosario, F. S., and D. K. Link. 1981. Volcano erupts north of Saipan. Pacific Daily News, May 16, 1981:1-2.
- Rosewater, J. 1965. The family Tridacnidae in the Indo-Pacific. Indo-Pac. Moll. 1(6):347-394.
- Rosewater, J. 1970. The family Littorinidae in the Indo-Pacific. Part I. The subfamily Littorininae. Indo-Pac. Moll. 2(11):417-506.
- Sablan, M. C. 1972. On the go. Pagan. Micronesia Reporter 20(2):44-46.
- Sablan, M. C. 1975. Anatahan. Micronesia Reporter 23(1):37-38.
- Sanchez y Zayas, E. 1866. The Mariana Islands: discovery and population. Nautical Mag. 35:462-472.
- Schmidt, G. R., and P. E. Cloud, Jr. 1949. Report on a reconnaissance study of the geology of Alamagan, Pagan, and Agrihan, Northern Mariana Islands. Pac. Geol. Surv. Military Geol. Branch, U.S. Geol. Surv. Tokyo. 14 p.
- Seidel, H. 1903. Klima und wetter auf den Marianen. Ann. Hydrogr. Marit. Meteorol. 31:139-144.
- Seventh Air Force. 1946? Pilot's guide. Marianas. A.C. of S., A-2 Seventh Air force No. 97.
- Shigematsu, R. 1944. A brief note on the depths of sea in the vicinity of the Mariana Islands. Rec. Oceanogr. Works Japan 5(1):99-104.
- Skinner, M. 1981. Pagan: volcanic devastation. Sunday News, May 31, 1981:8-9.
- Skipjack Programme. 1980. Skipjack fishing effort and catch, 1972-1978, by the Japanese pole-and-line fleet within 200 miles of the countries in the area of the South Pacific Commission. Skipjack Turney and Assessment Programme, S.P.C., Tech. Rept. 2. 91 p.

- Skipjack Programme. 1981. Fishing effort and catch by the longline fleets of Japan (1962-77) and Taiwan (1967-77) within 200 miles of the countries in the area of the South Pacific Commission. Skipjack Survey and Assessment Programme, S.P.C., Tech. Rept. 3. 249 p.
- Smith, M. 1964. Four winds and five islands. Journal of a Trust Territory field trip. Guam Times Weekly 1(17):14-21, 1(18):20-25
- Smithsonian Institution. 1981. Volcanoes of the world. Hutchinson Ross Publ. Co., Stroudsburg, Penna. 232 p.
- Stern, R. J. 1978. Agrigan: an introduction to the geology of an active volcano in the northern Mariana Island arc. Bull. Volcanol. 41-1:1-13.
- Stern, R. J. 1979. On the origin of andesite in the northern Mariana Island arc: implications from Agrigan. Contrib. Mineral. Petrol. 68:207-219.
- Stern, R. J. 1981. A common mantle source for Mariana and Volcano Arc and Caroline and Kilauea "hotspot" magmas: a consideration of the trace elements and isotopic evidence. EOS 62(17):408. [abstract]
- Stern, R. J., and L. D. Bibee. 1980a. Esmeralda [sic] Bank: the structure and geochemistry of an active submarine volcano in the Mariana Island Arc. Abstracts with Programs, Cordilleran Section, Geological Society of America. p. 154.
- Stern, R. J., and L. D. Bibee. 1980b. Esmeralda Bank: geochemistry of an active submarine volcano in the Mariana Islands Arc and its implications for magmagenesis in island arcs. Carnegie Inst. Washington Yearbook 79:465-472.
- Stern, R. J., and E. Ito. 1981. Oxygen, strontium, and neodymium isotopic and incompatible trace element constraints on the origin of melts in the Mariana and Volcano Island Arcs. Internat. Assoc. Volcanol. Chem. Earth's Interior, Tokyo-Hakone, pp. 328-349.
- Steward, K. B. 1980a. Farallon de Pajaros. New Pacific Mag. 5(3):34-35.
- Steward, K. B. 1980b. Trolling through Micronesia. New Pacific Mag. 5(3):44-45.
- Stojkovich, J. O. 1977. Revision of the pantropical algae genus Avrainvillea Decaisne (Codiales, Codiaceae). M.S. Thesis, University of Guam. 148 p.
- Stone, J., and D. Stone. 1974. Idyllic island of Agrihan. The Sunday News, 13 January 1974, pp. C4-C5.

- Takahashi, K. 1942. Ecology of tropical resources. Tyu-gin-sha, Tokyo. [in Japanese]
- Tanakadate, H. 1937. Investigation of Uracas volcano. South Sea Group Branch Office. 7 p. [in Japanese]
- Tanakadate, H. 1940. Volcanoes in the Mariana Islands in the Japanese Mandated South Seas. Bull. Volcanol., Ser. 2, 6:199-223.
- Tayama, R. 1936. Geomorphology, geology, and coral reefs of the northern Mariana group. Inst. Geol. Paleontol. Tohoku Univ. 23:1-88.
- Tayama, R. 1937. On the crustal movement of the groups and submarine ridges in the western part of the South Sea islands. Rept. Fac. Sci., Inst. Geol. Paleontol., Tohoku Imp. Univ. 28:1-33. [in Japanese]
- Juan C. Tenorio & Associates, Inc. 1979? Ornithological survey of wetlands in Guam, Saipan, Tinian and Pagan. Corps of Engineers, Pacific Ocean Division, Department of the Army. 202 p.
- Tobias, W. J. 1975. Marine benthic algae from the northern Mariana Islands. Unpubl. Graduate Report. 16 p.
- Toyohara, G. 1936. Geophysical observations in the Mandated South Sea Islands. J. Geogr. 48(6564-565):53-66, 136-142. [in Japanese]
- Towa Real Estate, Inc. 1970. A study for tourist resort development. Pagan, Mariana Islands. Tokyo. 20 p.
- Townsend, C. H. 1935. The distribution of certain whales as shown by logbook records of American whaleships. Zoologica 29(1):1-50.
- Tsuda, R. T., and W. J. Tobias. 1977a. Marine benthic algae from the northern Mariana Islands, Chlorophyta and Phaeophyta. Bull. Japan. Soc. Phycol. 25(2):67-72.
- Tsuda, R. T., and W. J. Tobias. 1977b. Marine benthic algae from the northern Mariana Islands, Cyanophyta and Rhodophyta. Bull. Japan. Soc. Phycol. 25(3):155-158.
- Tsuya, H. 1937. On the volcanism of the Huzi volcanic zone with special reference to the geology and petrology of Izu and the southern islands. Bull. Earthqu. Res. Inst. 15:215-357.
- Uchida, R. N. 1978. Narrative report Townsend Cromwell, Cruise 78-02 (TC-79). National Marine Fisheries Service.
- Uchida, R. N. in press. A review of the plankton communities and fishery resources of Guam and the Commonwealth of the Northern Mariana Islands. Nat. Mar. Fish. Serv., Honolulu.

- U. S. Department of Commerce. n.d. Final environmental impact statement and proposed coastal resources management program for the Commonwealth of the Northern Mariana Islands. Office of Coastal Zone Management, Department of Commerce, Washington, D.C. 212 p.
- U. S. Naval Oceanographic Office. 1964. Sailing directions for the Pacific Islands. Volume I. Western groups, including the Solomon Islands. H. O. Pub. No. 82. [pages 389-392 for Anatahan to Uracas]
- U. S. Naval Weather Service Command. 1971. Summary of synoptic meteorological observations. Hawaii and selected North Pacific island coastal marine area. Volume 4. Area 11--Ponape, Area 12--Truk, Area 13--Pagan. U.S. Naval Weather Service Command.
- U. S. Office of Naval Operations. 1944. Civil affairs handbook Mandated Mariana Islands. OPNAV 50E-8:1-205.
- Utinomi, H. 1952. Bibliography of Micronesia. Univ. Hawaii Press, Honolulu. 157 p.
- Vermeij, G. J., L. G. Eldredge, and E. A. Kay. in press. Molluscs of the northern Mariana Islands, with special reference to the selectivity of oceanic dispersal barriers. *Micronesica*.
- Walsh, E. A. 1970. Magnificent ordeal. Carlton Press, N. Y. 186 p.
- Ward, R. G. 1967. American activities in the central Pacific 1790-1870. A history, geography and ethnography pertaining to American involvement and Americans in the Pacific taken from contemporary newspapers, etc. The Gregg Press, Ridgewood, N.J. 8 vol.
- White, J. 1976. North from Saipan. *Islander*, 15 August 1976, pp. 6-7.
- Wooster, D. S. 1979. The shallow-water hermit crabs of the Mariana Islands (Decapoda, Paguridea: Coenobitidae, Diogenidae, Paguridae). M.S. Thesis, Univ. Guam. 171 p.
- Wooster, D. S. in press. The genus *Calcinus* (Paguridea, Diogenidae) from the Mariana Islands including three new species. *Micronesica* 18(2).
- Yamashina, Y. 1932. New species of bats found in the Mandated South Sea Islands. *Trans. Nat. Hist. Soc. Formosa* 22(121):240-241.
- Yamashina, Y. 1940. Some additions to the "List of the birds of Micronesia." *Tori* 10:673-679.
- Yasamatsu, K. 1940. Voyage to Pagan Island in the Marianas. *Akitsu* 2(4):180-188. [in Japanese]

- Yawata, T. 1940a. Ancient relics from Alamagan, Mariana Islands. J. Anthropol. Soc. Tokyo 55(8):353-359. [in Japanese, Cross Cultural File Translation No. 1444]
- Yawata, T. 1940b. Prehistorical exploration in the northern part of the Mariana Islands. J. Anthropol. Soc. Tokyo 55(6):257-262. [in Japanese, Cross Cultural File Translation No. 1443]
- Yoshii, M. 1936. Brief notes on noncalcareous rocks of Micronesia. Contrib. Fac. Sci., Inst. Geol. Paleontol., Tohoku Imp. Univ. 22:1050.
- Youngblood, E. and A. Meijer. 1978. Petrology and geochemistry of an island arc sequence, Sarigan, Mariana Islands. EOS 59:1182.

- Agrihan, birds--Borrer 1974,
Jouanin 1959
- Agrihan, general--Esser 1982,
Stone and Stone 1974,
Daley 1976
- Agrihan, geology--Schmidt and
Cloud 1949, Stern 1978,
1979
- Agrihan, Volcano--Hasegawa 1917
- Alamagan, archaeology--Yawata
1940a
- Alamagan, general--Esser 1982
- Alamagan, geology--Schmidt and
Cloud 1949
- Algae--Gilbert 1978, Itono,
1980, Stojkovich 1977,
Tobias 1975, Tsuda and
Tobias 1977a, 1977b
- Anatahan, general--Sablan 1975
- Anatahan, history--Fukami and
Cross 1969, Maruyama 1954
- Aquatic ecosystems--Best 1981,
Best and Davidson 1981
- Archaeology--Chapman 1964,
Yawata 1940b
- Archaeology, Alamagan--Yawata
1940a
- Archaeology, Pagan--Egami and
Saito 1973
- Bats--Yamashina 1932
- Beaches, Pagan--Doan and
Siegrist 1979
- Bibliography--Hatanaka 1979,
Quinn 1978, Utinomi 1952
- Birds--Baker 1951, Falanruw
1975, Hartert 1898, King
1967, Yamashina 1940
- Birds, checklist--Owen 1977
- Birds, Agrihan--Borrer 1947,
Jouanin 1959
- Birds, Pagan--Juan C. Tenorio &
Assoc., Inc. 1979
- Bivalves--Rosewater 1965
- Botany--Anderson 1950, Hosokawa
1934a, 1934b, Kanehira
1934
- Charts--Polovina and Roush 1982
- Climate--Chief of Naval Opera-
tions Operations 1944,
CINPAC-CINCPOA 1945,
Eldredge in press, Seidel
1903
- Climate, Pagan--U.S. Naval
Weather Service Command
1971
- Coral reefs--Tayama 1936
- Crabs--Eldredge 1980, Wooster
1979, in press
- Earthquakes--Anon. n.d.
- Echinoids--Nishiyama 1942
- Environment--Abbott et al.
1982, Baker 1975, Eldredge
1975, 1982
- Environment, Maug--Eldredge et
al. 1977, Lindblad
Explorer 1976, 1977
- Environment, Pagan--Baschin
1927, Doan and Siegrist
1979, Eldredge 1982
- Eruption, Pagan--Koyanagi and
Honma 1981, Hastings
1982, Phillips 1981,
Rosario and Link 1981,
Eldredge 1981,
Skinner 1981
- Esmeralda, volcano--Gavrilenko
1981, Gavrilenko et al.
1980, Stern and Bibee
1980a, 1980b
- Farallon De Pajaros, general--
Steward 1980a
- Fisheries--Hosmer and Kami
1981, CNMI 1980, Japan
Marine Fishery Resources
Research Center 1975,
1976, 1977, Kearney et al.
1979, 1980, Micronesian
Coordinated Development
Co., Ltd. 1976, Polovina
and Roush 1982, Polovina
and Shippen 1983, Skipjack
Programme 1980, 1981,
Steward 1980b, Uchida in
press.
- Fishes--Gawel 1975, Jones et
al. n.d.
- Flora--Fosberg et al. 1975,
1977, 1979, 1980, 1982,
Hosokawa 1934a, 1934b,
Kanehira 1934
- Flora, Pagan--Fosberg 1958,
1960

- Gastropods--Abbott 1959, 1960, 1961, 1968, Burn 1974, Carlson and Hoff 1972, Cernohorsky 1976, Dickinson 1976, Emerson and Cernohorsky 1973, Houbrick 1978, Powell 1973, Rosewater 1970, Vermeij et al. in press
- Gastropods, Pagan--Kondo 1950, 1970
- General--Eldredge 1975, Evans 1977, Farrell 1979, Fritz 1902, Joint Intelligence Center 1944a, 1944b, Kanamuru 1936, Kluge 1968, 1980, Lehne and Gabler 1972, Naval Intelligence Division 1945, Prowezak 1913, Ronck 1975a, 1975b, 1975c, Seventh Air Force 1946, Smith 1964, White 1976, Walsh 1970, U.S. Office of Naval Operations 1944
- General, Agrihan--Daley 1976, Stone and Stone 1974
- General, Anatahan--Sablan 1975
- General, Pagan--Corwin et al. 1975, Farrell 1980, Kiener 1977, Sablan 1972, Yasamatsu 1940
- Geologic names, Pagan--Endo 1949
- Geology--Dixon and Batiza 1979, Inoyama 1935, Karig 1971, Koert and Finckh 1920, Larson et al. 1974, Meijer 1976, 1981, Meijer and Glasley 1973, Meijer and Reagan 1981, Meijer et al. 1981, Stern 1981, Tayama 1936, 1937, Toyohara 1936, Tsuya 1937, Yoshii 1936
- Geology, Agrihan--Schmidt and Cloud 1949, Stern 1978, 1979
- Geology, Alamagan--Schmidt and Cloud 1949
- Geology, Pagan--Corwin et al. 1957, Kaiser 1907, Schmidt and Cloud 1949
- Geology, Sarigan--Meijer and Reagan 1981, Youngblood and Meijer 1978
- Giant clams--Rosewater 1975
- History--Baker 1975, Beechey 1831, Corte 1926-27, Eldredge in press, Fritz 1902, Fukami and Cross 1969, Garcia 1683, Ibanez y Garcia 1886, La Perouse 1797, Marche 1891, Maruyama 1954, Ohashi 1917, Sanchez y Zayas 1866
- Maug, environment--Eldredge et al. 1977, Lindblad Explorer 1976, 1977
- Megapodes--Falanruw 1975
- Minerals--DelaCruz 1971
- Oceanography--deWitt 1972, Eldredge in press, Shigematsu 1944
- Opisthobranchs--Carlson and Hoff 1972
- Pagan, aquatic ecosystems--Best 1981, Best and Davidson 1981
- Pagan, archaeology--Egami and Saito 1973
- Pagan, beaches--Doan and Siegrist 1979
- Pagan, birds--Juan C. Tenorio & Assoc., Inc. 1979
- Pagan, climate--U.S. Naval Weather Service Command 1981
- Pagan, environment--Baschin 1927, Doan and Siegrist 1979, Eldredge 1982
- Pagan, eruption--Banks 1981, Banks and Honma 1981, Eldredge 1981, Koyanagi and Honma 1981, Link 1982, Phillips 1981, Rosario and Link 1981, Skinner 1981
- Pagan, flora--Fosberg 1958
- Pagan, fossil flora--Fosberg and Corwin 1958
- Pagan, gastropods--Kondo 1950, 1970

- Pagan, general--Corwin et al.
1957, Esser 1982, Evans
1977, Farrell 1980, Joint
Intelligence Center 1944a,
1944b, Kiener 1977, Sablan
1972, Yasamatsu 1940
- Pagan, geologic names--Endo
1949
- Pagan, geology--Corwin et al.
1957, Schmidt and Cloud
1949
- Pagan, land snails--Kondo 1950,
1970
- Pagan, planning--Pangelinan and
Kapileo 1970, Towa Real
Estate, Inc. 1970, Pacific
Planning and Design
Consultants 1978
- Preservation--Eldredge 1977,
Elliot 1973
- Place names--Bryan 1943, 1971
- Plankton--Uchida in press
- Planning--Ikeguchi and Castro
1975, Johnson 1957
- Planning, outdoor recreation--
H. Mogi 1977
- Planning, Pagan--Pangelinan and
Kapileo 1970, Towa Real
Estate, Inc. 1970, Pacific
Planning and Design
Consultants 1978, U.S.
Dept. Commerce n.d.
- Resources--Takahashi 1942
- Ruby, volcano--Johnson 1973
- Sarigan, geology--Meijer and
Reagan 1981, Youngblood
and Meijer 1978
- Sailing directions--U.S. Naval
Oceanographic Office 1964
- Submarine topography--Eldredge
in press
- Uracas, general--Steward 1980a
- Uracas, volcano--Tanakadate
1937
- Volcano, Pagan--Banks 1981,
Banks and Honma 1981
- Volcano, Ruby--Johnson 1973
- Volcano, Uracas--Tanakadate
1937
- Volcanoes--Kuno 1962, Maso,
1902, Smithsonian
Institution 1981
- Volcanoes, Agrihan--Hasegawa
1919
- Volcanoes, Esmeralda--
Gavrilenko 1981,
Gavrilenko et al. 1982,
Stern and Bibee 1980a,
1980b
- Whaling--Langdon 1979, Martin
1979, Townsend 1935, Ward
1967