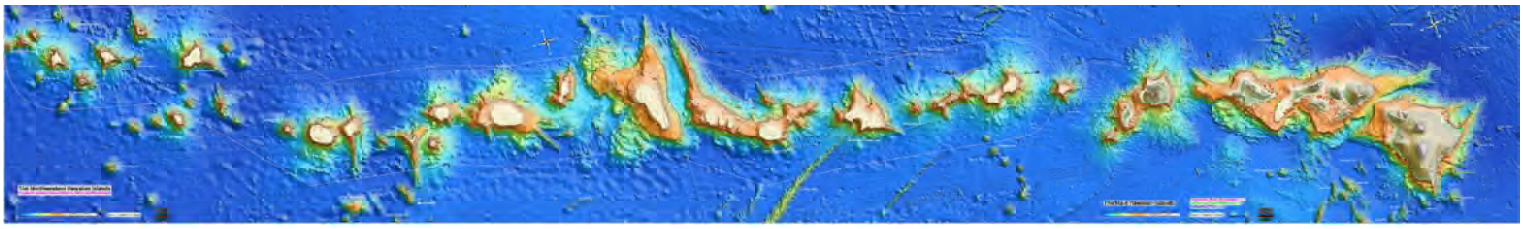
Life and Death of Hawaiian Volcanoes:
A Jigsaw Activity on the Hawaiian Ridge



PART 1: Specialty Groups

- (A) Shield Volcanoes
- (B) Giant Landslides
- (C) Volcano Ages
- (D) Volcano Volumes
- (E) Subsidence

PART 2: Synthesis Groups

(1)	(2)	(3)	(4)
- Shield Volcanoes	- Shield Volcanoes	- Shield Volcanoes	- Shield Volcanoes
- Giant Landslides	- Giant Landslides	- Giant Landslides	- Giant Landslides
- Volcano Ages	- Volcano Ages	- Volcano Ages	- Volcano Ages
- Volcano Volumes	- Volcano Volumes	- Volcano Volumes	- Volcano Volumes
- Subsidence	- Subsidence	- Subsidence	- Subsidence

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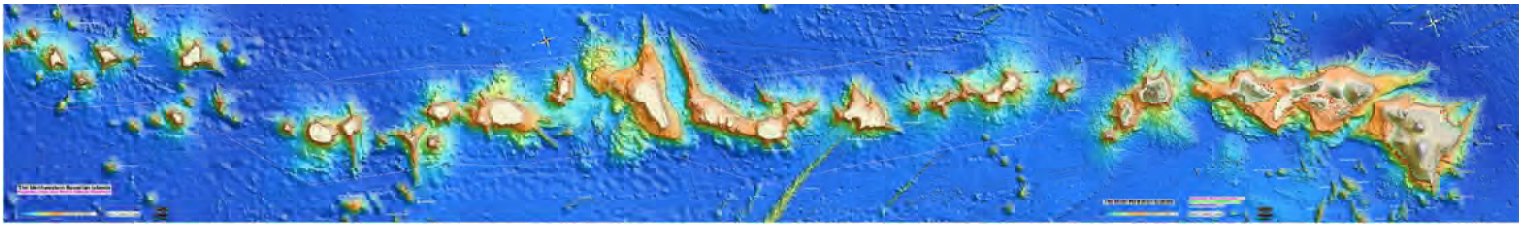

Activity Schedule

** ***[Students should complete pre-activity reading before the activity. Send to students as an elctronic pdf or print and give to them several days in advance.]*** **

(10 minutes) - Introduction to activity.

(1 hour) **PART 1: Specialty Groups exercise**

- (A) Shield Volcanoes
- (B) Giant Landslides
- (C) Volcano Ages
- (D) Volcano Volumes
- (E) Subsidence

(Specialty group files A through E for printing)

(5-10 minutes) **— Break —**

PART 2: Synthesis Groups

(20-30 minutes) - Teach other specialists about your specialty.

- Ask students to do this by showing example up at the wall map

(20-30 minutes) - Complete synthesis diagrams and writeup of Growth and Degradation of Hawaiian Volcanoes with your **Synthesis Group.** **(Synthesis_Part2.pdf)**

(10-20 minutes) - Discussion and summary by instructor about the Hawaiian Ridge and 'Life and Death of Hawaiian Volcanoes'.

(Total time approximately 2:05-2:40 hours)

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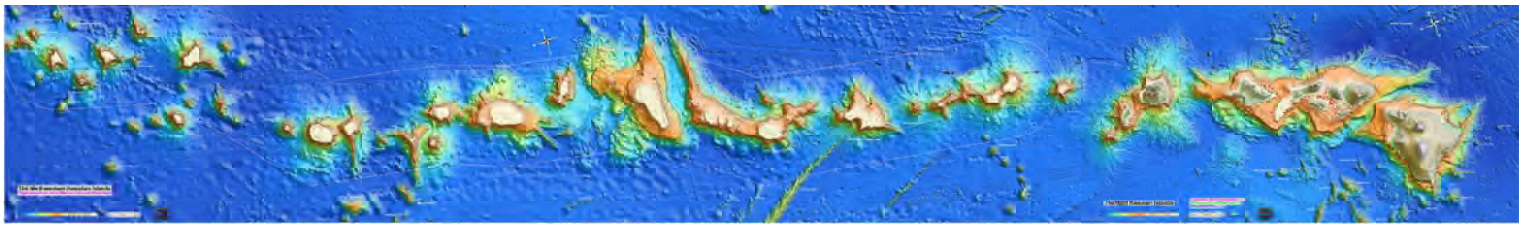

List of Files for Printing

	Contents
	For instructor only
1_Instructor files_keys.pdf	1_Intro-instructor_Jigsaw-format 1_Intro-instructor_Activity-schedule 1_Intro-instructor_List-files-for-printing 1_Intro-instructor_Maps-supplies-needed B_Giant_Landslides_maps (*in COLOR) Instructor keys
2_Pre-activity Reading.pdf	**For whole class (as electronic pdf or print in advance)** 1_Pre-activity_reading (*in COLOR, or as electronic pdf)
PART 1: Specialty Groups	**For five specialty groups** ***(for each set, print enough for one-fifth of students)****
A_Shield Volcanoes.pdf	A_Instructions-questions_Shield_Volcanoes A_Shield_table A_Shield_graph
B_Giant Landslides.pdf	B_Instructions-questions_Giant_Landslides B_Giant_Landslides_Hawaiian_Islands_map (*in COLOR) B_Giant_Landslides_Gardner-Maro_map (*in COLOR)
C_Volcano Ages.pdf	C_Instructions-questions_Volcano_Ages C_Volcano_Ages-table C_Volcano_Ages-graph
D_Volcano Volumes.pdf	D_Instructions-questions_Volcano_Volumes D_Volcano_Volumes-table D_Volcano_Volumes-graph
E_Subsidence.pdf	E_Instructions-questions_Subsidence E_Subsidence_table E_Subsidence_graph E_Subsidence_Hawaii_map (*in COLOR) E_Subsidence_Oahu_map (*in COLOR) E_Subsidence_Gardner-Maro_map (*in COLOR)
PART 2: Synthesis Groups	**For whole class (print enough for all students)**
Synthesis_Part2.pdf	2_Instructions-questions_Part_2 2_Growth_degradation_figures_Part_2 (*in COLOR)

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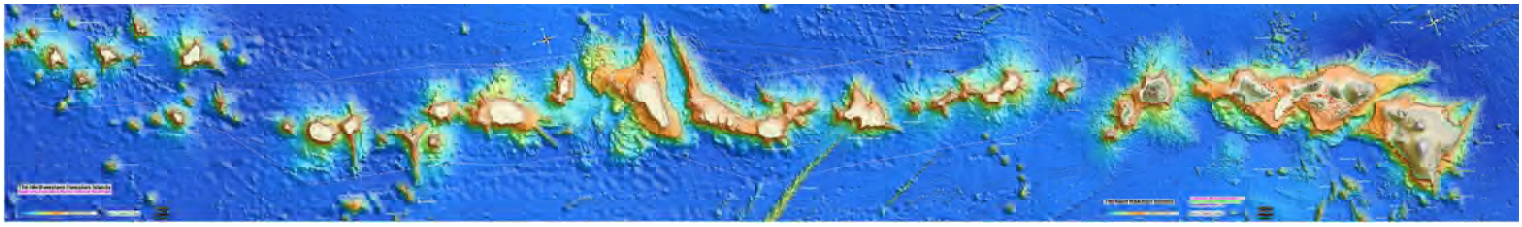


Maps Needed for Activity

[One copy of each needed]

1) Kure to Lisanski (41" x 62")
2) Pioneer Bank to Brooks Bank (41" x 77")
3) French Frigate Shoals to Nihoa (41" x 66")
4) Main Hawaiian Islands (41" x 66")

[This is the primary expense for this lab activity, but well worth it. Have maps printed on high-quality glossy paper for the best preservation and visibility. Putting tape over corners of the maps where tacks are used for securing to the wall helps preserve the maps.]

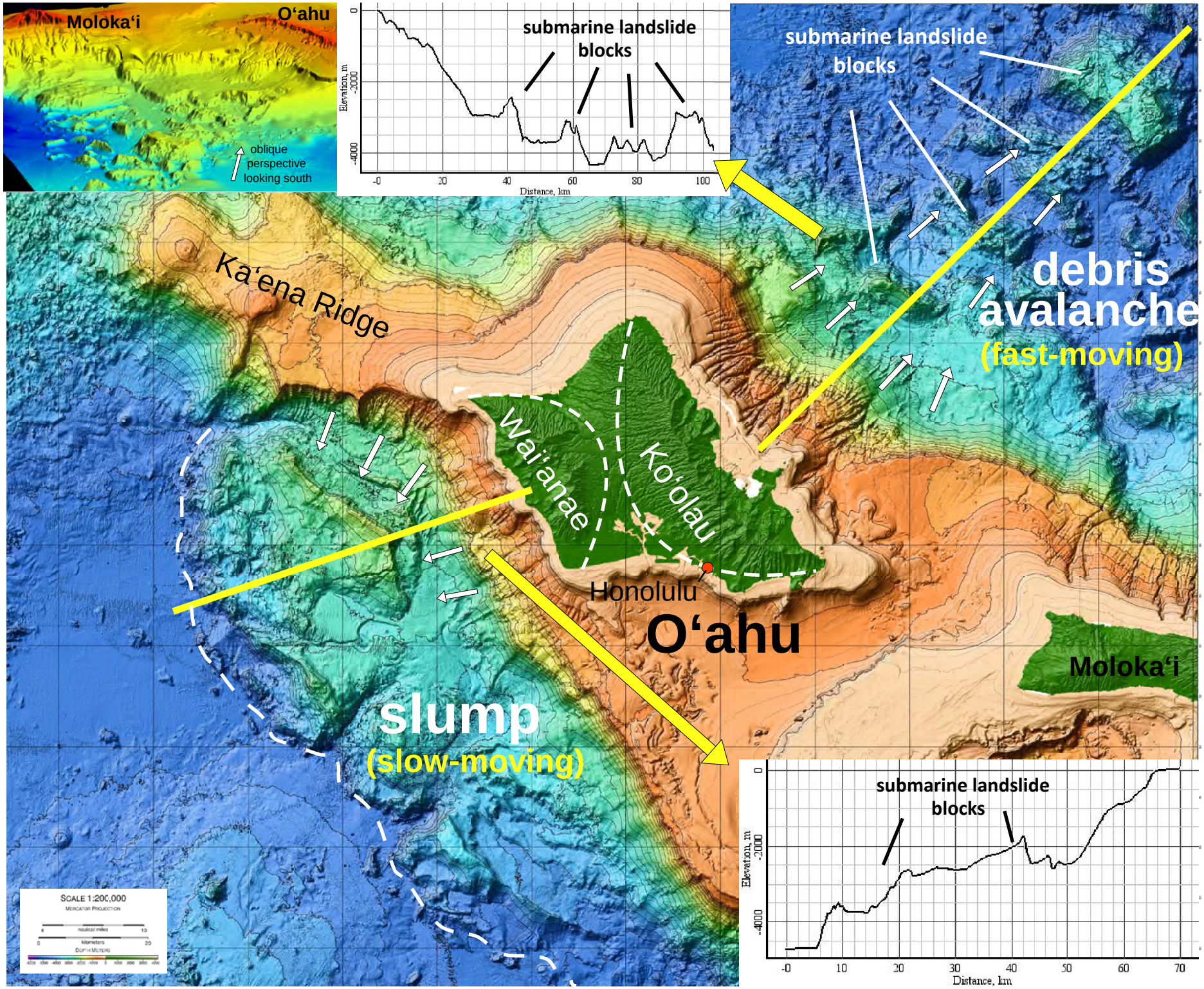
Supplies Needed for Activity

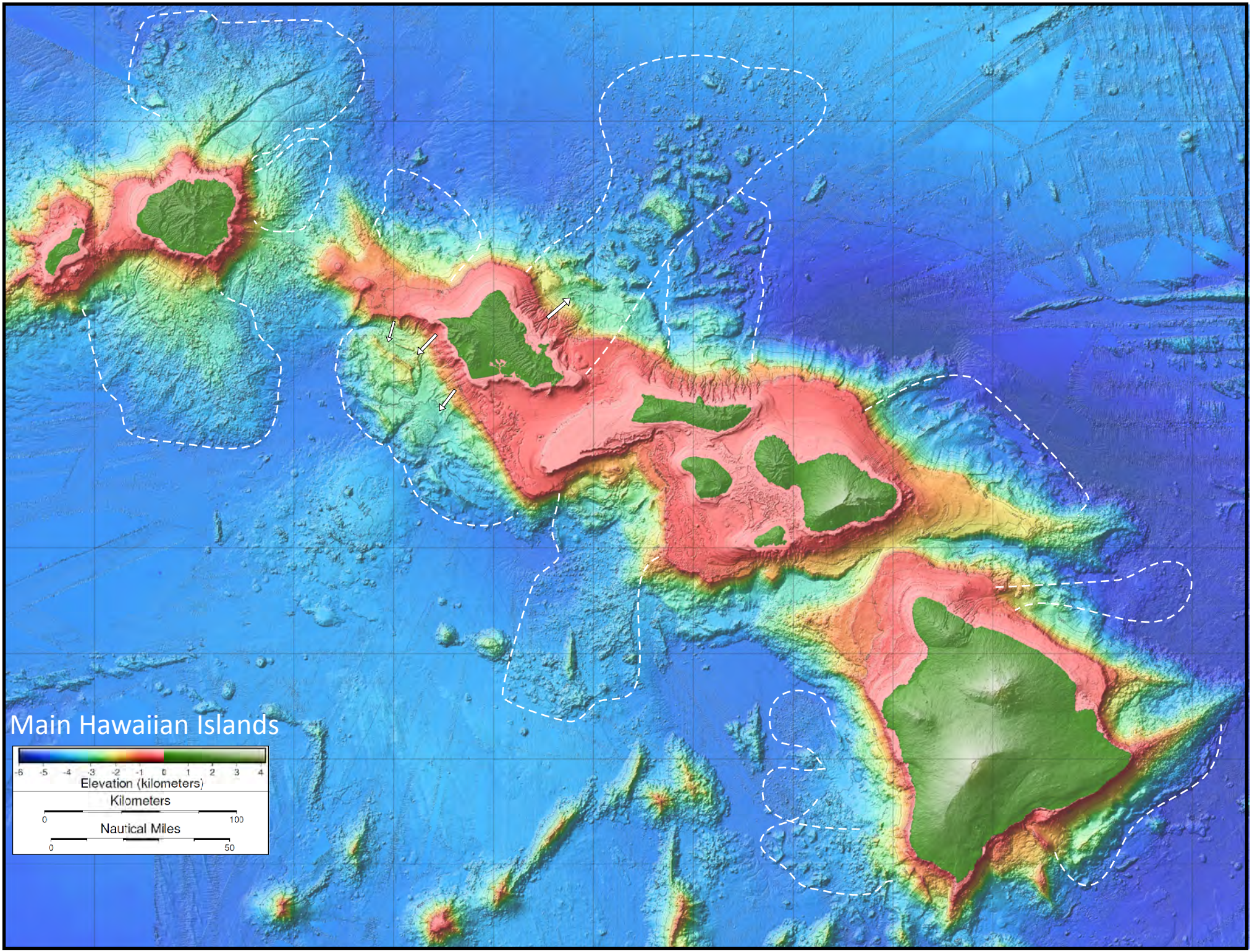
1) Tape measures (8 m/26' long) or sections of string marked with measurements
   (4-5 for the Volcano Ages specialty group)

2) Plastic or paper full circle protractors (can print 360° protractor)
   (4-5 for the Shield Volcano specialty group)

3) Plastic 30-cm metric ruler
   (4-5 for the Volcano Volume specialty group)

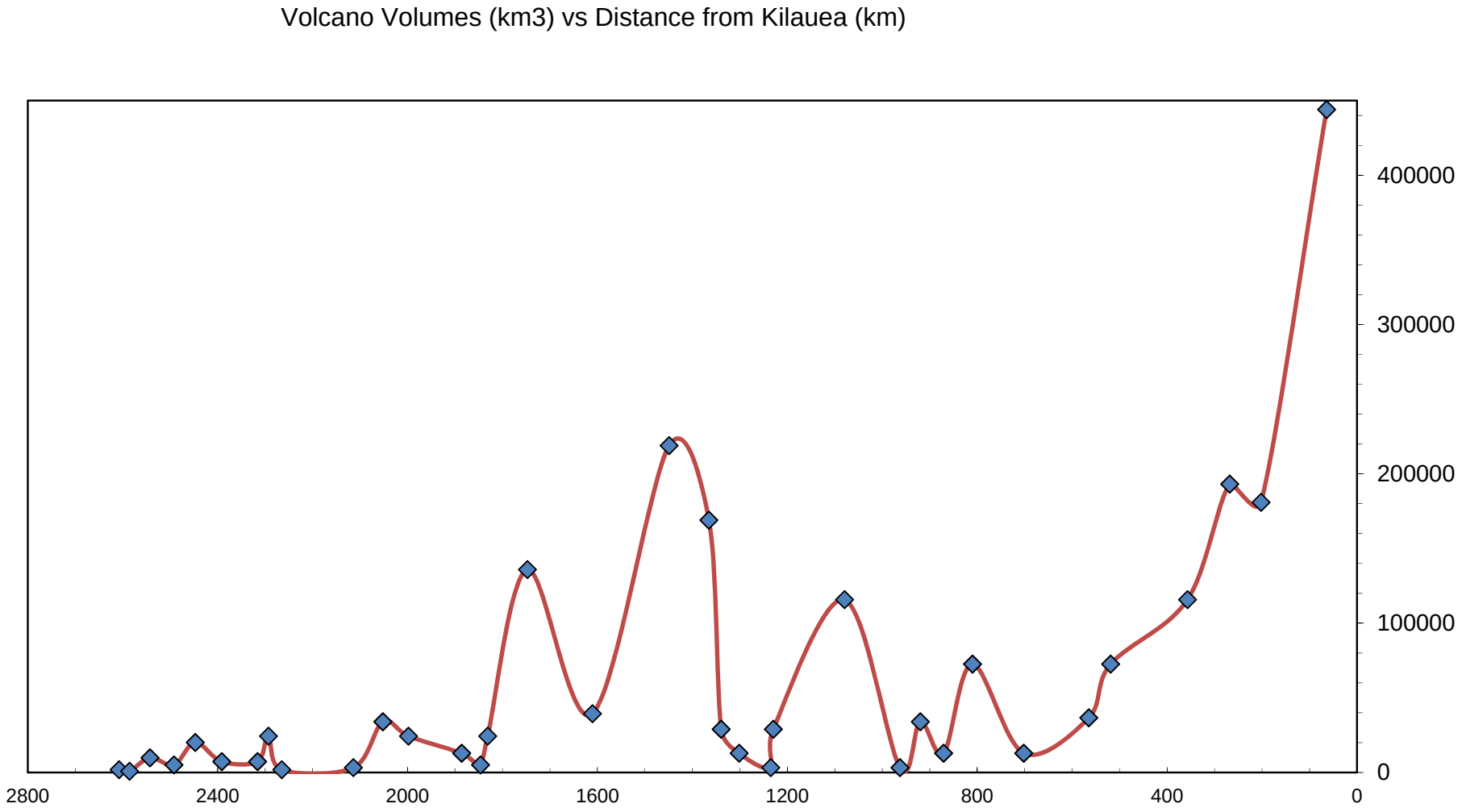
4) Calculators (or phones with calculators) for all groups, except Giant Landslides


Moloka‘i
O‘ahu
oblique perspective looking south
submarine landslide blocks
Elevation, m
Distance, km
submarine landslide blocks
debris avalanche
(fast-moving)
Ka‘ena Ridge
Wai‘anae
Ko‘olau
Honolulu
O‘ahu
Moloka‘i
slump
(slow-moving)
SCALE 1:200,000
submarine landslide blocks
Elevation, m
Distance, km


Main Hawaiian Islands
-6 -5 -4 -3 -2 -1 0 1 2 3 4
Elevation (kilometers)
Kilometers
0
100
Nautical Miles
0
50

VOLCANO AGES FOR HAWAIIAN RIDGE VOLCANOES

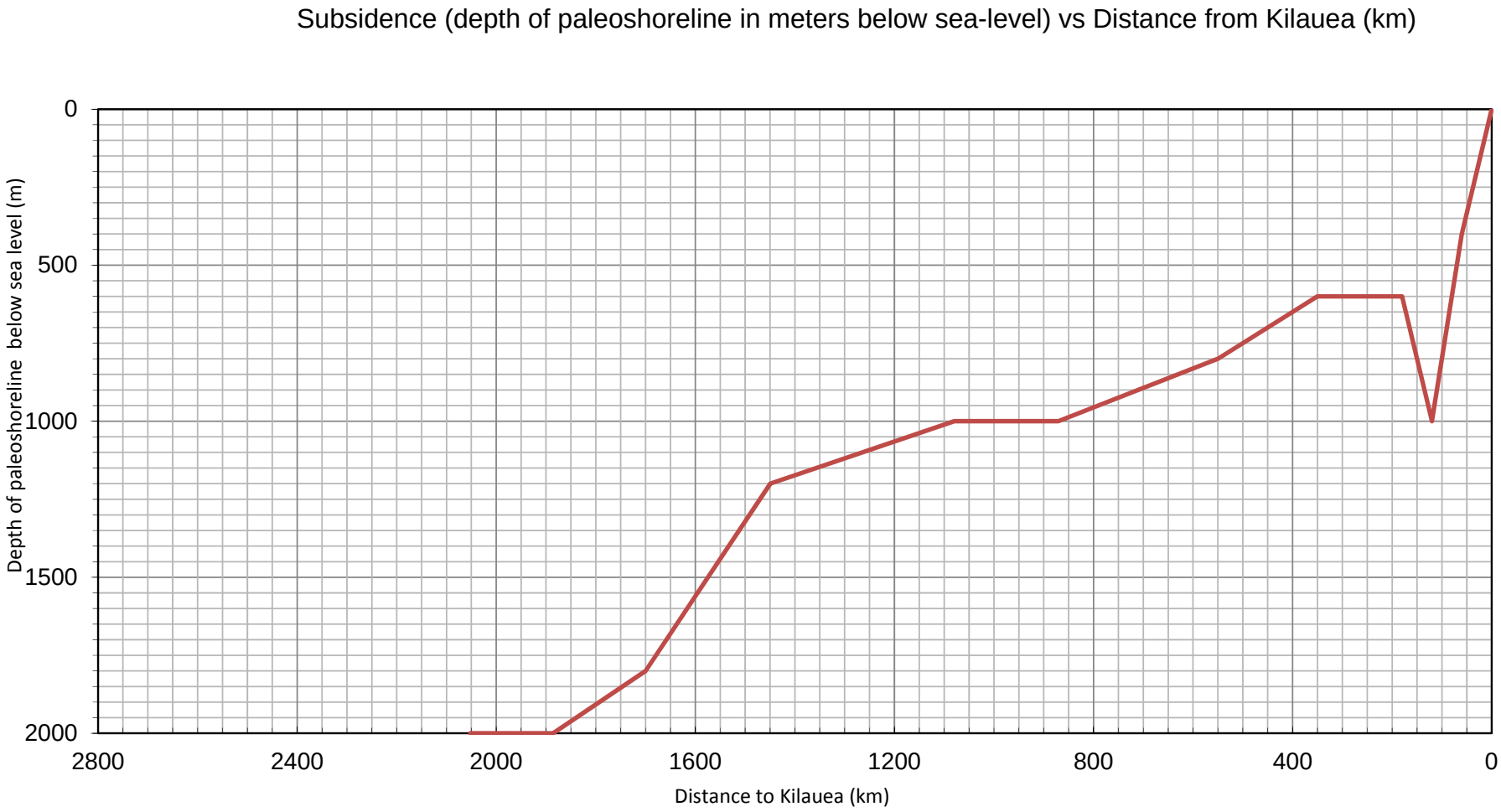
	#	Volcano name	Dist. from Kilauea (km)	Age (Million years)
	1	Academician Berg	2608	31.0
	2	Turnif	2586	29.3
	3	Kure	2543	
	4	Nero	2492	
	5	Midway	2447	27.6
	6	Ladd	2391	
	8	Salmon Bank	2316	
	7	Pearl & Hermes	2293	24.7
	9	Kilo Moana	2114	
	10	Lisianski	2052	
	11	Pioneer Bank	1998	
	12	Kaiuli	1940	
	13	W. Northampton	1886	
	14	E. Northampton	1846	19.9
	15	Laysan	1831	20.7
	16	Mōlī	1795	
	17	Maro East	1747	
Northwest	18	Maro West	1682	
Hawaiian Islands	19	Raita	1611	
	20	NW Gardner	1514	
	21	Gardner	1449	12.3
	22	West St. Rogatien	1365	
	23	St. Rogatien Bank	1339	
	24	W. Brooks Bank	1317	
	25	Brooks Bank	1302	13.0
	26	SE Brooks Bank	1284	
	28	Kānehunamoku	1235	
	27	French Frigate Shoals	1230	12.0
	30	Mokumanamana	1080	10.3
	31	Necker SE	1045	
	32	Keoea	963	
	33	Twin Banks West	920	9.6
	34	Twin Banks East	901	
	35	Westpac Bank	871	
	36	Nīhoa West	825	
	37	Nīhoa East	794	7.5
	38	Middle Bank	702	
	39	Niʻihau	565	5-6
	40	Kauaʻi	519	4-5.8
	41	Waiʻanae, Oʻahu	374	3-3.9
	42	Koʻolau, Oʻahu	339	1.8-3.3
	43	West Molokaʻi	280	1.8-2.1
	44	East Molokaʻi	256	1.5-1.8
Main Hawaiian	45	Lānaʻi	226	0.8-1.3
Islands	46	West Maui	221	1.4-2
	47	Kahoʻolawe	185	0.9-1.2
	48	Haleakalā	182	0.2-2
	49	Māhukona, Hawaiʻi	145	0.4-0.6
	50	Kohala, Hawaiʻi	100	0.4-1.1
	51	Hualālai, Hawaiʻi	65	0.2-0.8
	52	Mauna Kea, Hawaiʻi	54	0.2-0.6
	53	Mauna Loa, Hawaiʻi	20	0-0.6
	54	Kīlauea, Hawaiʻi	0	0-0.3


Volcano Volumes (km3) vs Distance from Kilauea (km)
400000
300000
200000
100000
0
2800
2400
2000
1600
1200
800
400
0

SUBSIDENCE FOR HAWAIIAN RIDGE VOLCANOES

	Island or Volcano name (area to estimate paleoshoreline)	Depth of Paleoshoreline (m)	Dist. from Kilauea (km)	Estimated Age (Myr)
Northwest Hawaiian Islands	Lisianski (N side)	2000	2052	*21**
	West Northampton (NE side)	2000	1886	*20**
	Maro (ENE side)	1800	1700	*17**
	Gardner (N side)	1200	1449	12.3
	Mokumanamana (NE of seamount)	1000	1080	10.3
	Twin Banks (N of seamount)	1000	920	9.6
	Westpac Bank (N of seamount)	1000	871	*8**
Main Hawaiian Islands	Kauaʻi (WNW of island)	800	550	5.0
	Oʻahu (N of North tip island)	600	350	2.5
	Maui (N of Haleakala)	600	180	1.5
	Hawaiʻi (N of Kohala)	1000	120	1.1
	Hawaiʻi (E of Mauna Kea)	400	60	0.6
	Hawaiʻi (S of Kilauea)	0	0	0.0

* interpreted age


Subsidence (depth of paleoshoreline in meters below sea-level) vs Distance from Kilauea (km)
Depth of paleoshoreline below sea level (m)
0
500
1000
1500
2000
2800
2400
2000
1600
1200
800
400
0
Distance to Kilauea (km)