

Table DR 1. Chemical analyses of basalt clasts and glass fragments, South Kona slide complex, Ha

Table DR 1-A. Whole-rock analyses, South Kona slide complex. Analyses by XRF by Dave Siems at USGS, Denver,

Field No.	K210-3	K210-14A	S689-R3B	S689-R4	S689-R5	S689-R6	S693-R7	S694-R4	S694-R5
Sample	Basalt clast	Basalt breccia	Vesicular basalt clast	Vesicular basalt clast	Vesicular basalt clast	Vesicular basalt clast	Basaltic she sheet flow	Basalt clast	Vesicular basalt cl
Depth, mbs	3805	3045	3531	3474	3344	3233	2430	4103	3904
SiO ₂	51.00	50.60	50.30	50.30	49.70	51.50	50.80	48.00	48.
TiO ₂	2.31	1.89	1.99	2.20	2.24	2.18	2.47	1.67	1.
Al ₂ O ₃	14.30	12.50	12.60	13.10	13.60	13.80	14.30	11.60	12.
FeTO ₅	12.40	12.30	12.00	12.20	12.30	12.10	12.50	12.10	12.
MgO	6.49	10.40	9.65	8.28	8.10	7.00	5.76	13.20	11.
MnO	0.18	0.18	0.16	0.17	0.17	0.17	0.17	0.17	0.
CaO	10.80	10.10	9.94	10.80	10.90	10.70	10.20	9.28	10.
Na ₂ O	2.52	1.98	2.07	2.11	2.31	2.33	2.48	1.91	2.
K ₂ O	0.31	0.30	0.28	0.33	0.35	0.35	0.45	0.26	0.
P ₂ O ₅	0.26	0.21	0.22	0.25	0.25	0.24	0.28	0.17	0.
LOI	-0.13	0.00	0.39	0.06	0.05	-0.26	0.30	1.10	0.
TOTALS	100.44	100.46	99.60	99.80	99.97	100.11	99.71	99.46	99.

S695-R5A	S695-R6A	S695-R7B	S695-R11A	S714-R2B	S714-R5A	S714-R7B	S715-R3A	S715-R4A	S715-R6
Vesicular pahoehoe	Vesicular pahoehoe	Vesicular pahoehoe	Vesicular pahoehoe	Dense basal	Dense basal	Dense basal	Ol basalt	Aphyric den	Aphyric c
3272	3124	3116	3073	4331	4199	4152	4277	4215	4214
50.80	49.10	49.60	50.40	50.80	50.50	50.00	47.60	49.40	50.
1.93	1.67	1.87	1.86	2.11	2.10	2.03	2.48	1.50	2.
13.20	11.50	11.60	12.80	13.30	14.70	12.60	11.80	11.60	13.
11.90	12.40	12.80	12.40	12.00	11.60	11.90	13.00	11.70	11.
8.96	13.70	12.40	9.66	8.14	6.32	9.26	11.60	13.50	7.
0.17	0.17	0.17	0.18	0.16	0.16	0.17	0.17	0.16	0.
10.20	8.89	9.06	9.92	10.40	10.70	10.30	9.84	8.61	11.
2.19	1.92	2.01	2.15	2.32	2.49	2.10	2.11	2.05	2.
0.30	0.24	0.27	0.29	0.30	0.48	0.31	0.51	0.27	0.
0.21	0.19	0.21	0.21	0.23	0.28	0.23	0.32	0.18	0.
0.12	-0.09	-0.28	-0.10	0.20	0.35	0.56	0.30	0.49	0.
99.98	99.69	99.71	99.77	99.96	99.68	99.46	99.73	99.46	99.

Table DR 1-B. Whole-rock analyses, South Kona Kaiko dives K210 and K211. Analyses by XRF by H. Yokose at K

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| Sample <sup>a</sup>                                 | K210-1a                         | K210-1b             | K210-2              | K210-3#               | K210-4a        | K210-4b                               | K210-5              | K210-6              | K210            |
|-----------------------------------------------------|---------------------------------|---------------------|---------------------|-----------------------|----------------|---------------------------------------|---------------------|---------------------|-----------------|
| Occurrence                                          | VB                              | VB                  | Dike                | VB                    | Float          | Float                                 | VB                  | VB                  | 1               |
| Rock type                                           | breccia                         | volcanic ss         | lava                | breccia               | breccia        | breccia                               | volcanic ss         | volcanic ss         | 1               |
| Phenocryst<br>(mpheno.): %<br>Groundmass<br>texture | Ol: 1.7;<br>zeolite: 18.5<br>IS | aphyric < 1.0<br>IS | aphyric < 1.0<br>IG | aphyric < 1.0<br>n.d. | Ol: 9.6%<br>IS | Ol: 23.5<br>(oxidized)<br>devitrified | aphyric < 1.0<br>IS | aphyric < 1.0<br>IG | aphyric <<br>IG |
| Bulk rock chemistry (wt. %)                         |                                 |                     |                     |                       |                |                                       |                     |                     |                 |
| SiO <sub>2</sub>                                    | 48.64                           | 51.58               | 50.46               | 51.00                 | 49.48          | 47.54                                 | 51.05               | 50.73               | 50              |
| TiO <sub>2</sub>                                    | 2.06                            | 2.23                | 2.13                | 2.31                  | 1.78           | 1.51                                  | 2.30                | 2.24                | 2               |
| Al <sub>2</sub> O <sub>3</sub>                      | 11.30                           | 13.12               | 12.23               | 14.30                 | 10.53          | 8.60                                  | 12.81               | 13.18               | 13              |
| Fe <sub>2</sub> O <sub>3</sub>                      | 3.55                            | 5.38                | 2.20                | 12.30                 | 2.87           | 11.50                                 | 3.43                | 3.13                | 3               |
| FeO                                                 | 8.86                            | 6.58                | 9.57                | n.d.                  | 9.64           | 1.54                                  | 8.42                | 8.68                | 9               |
| MnO                                                 | 0.17                            | 0.16                | 0.16                | 0.18                  | 0.16           | 0.17                                  | 0.16                | 0.16                | 0               |
| MgO                                                 | 12.82                           | 7.58                | 9.92                | 6.49                  | 15.10          | 19.53                                 | 8.44                | 8.31                | 6               |
| CaO                                                 | 8.37                            | 11.24               | 10.14               | 10.80                 | 9.06           | 6.93                                  | 10.95               | 11.11               | 10              |
| Na <sub>2</sub> O                                   | 2.64                            | 2.02                | 2.12                | 2.52                  | 1.71           | 1.80                                  | 2.23                | 2.24                | 2               |
| K <sub>2</sub> O                                    | 1.23                            | 0.36                | 0.39                | 0.31                  | 0.29           | 0.50                                  | 0.26                | 0.32                | 0               |
| P <sub>2</sub> O <sub>5</sub>                       | 0.16                            | 0.20                | 0.19                | 0.26                  | 0.16           | 0.13                                  | 0.20                | 0.19                | 0               |
| Total                                               | 99.80                           | 100.45              | 99.51               | 100.47                | 100.79         | 99.74                                 | 100.26              | 100.29              | 100             |
| S (ppm)                                             | < 10                            | 20                  | < 10                | n.d.                  | < 10           | 30                                    | < 10                | < 10                |                 |

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| K210-12c      | K210-13       | K210-14a   | K210-15                   | K210-15c                       | K210-16    |
|---------------|---------------|------------|---------------------------|--------------------------------|------------|
| Float breccia | Float breccia | VB breccia | VB breccia                | VB breccia                     | VB breccia |
| aphyric < 1.0 | aphyric < 1.0 | Ol: 11.7   | Ol: 1.6;<br>zeolite: 18.3 | Ol: 5.4; (Cpx<br>: tr, Pl: tr) | Ol: 10.8   |
| IS            | Trachytic     | IS         | IS                        | IG                             | IS         |
| 50.21         | 49.66         | 49.67      | 49.74                     | 50.62                          | 51.15      |
| 2.01          | 3.47          | 1.85       | 2.20                      | 1.85                           | 2.07       |
| 12.69         | 15.04         | 11.90      | 11.33                     | 12.18                          | 12.42      |
| 5.31          | 7.92          | 1.99       | 4.13                      | 2.66                           | 3.87       |
| 6.79          | 6.23          | 11.64      | 8.50                      | 9.59                           | 8.17       |
| 0.17          | 0.15          | 0.17       | 0.17                      | 0.16                           | 0.16       |
| 9.10          | 5.65          | 9.80       | 12.29                     | 10.65                          | 9.43       |
| 10.31         | 8.49          | 10.04      | 8.89                      | 10.02                          | 10.44      |
| 2.37          | 3.20          | 1.93       | 2.76                      | 2.00                           | 1.99       |
| 0.23          | 0.99          | 0.29       | 0.91                      | 0.27                           | 0.32       |
| 0.18          | 0.42          | 0.17       | 0.19                      | 0.16                           | 0.18       |
| 99.37         | 101.23        | 99.45      | 101.10                    | 100.17                         | 100.21     |
| 80            | < 10          | 90         | < 10                      | < 10                           | < 10       |

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| Sample                         | K211-1              | K211-2              | K211-3a   | K211-3b  | K211-4  | K211-5a  | K211-6a | K211-6b  | K211-6c  |
|--------------------------------|---------------------|---------------------|-----------|----------|---------|----------|---------|----------|----------|
| unit                           | bedrock             | bedrock             | DFD1      | DFD 1    | DFD1    | bedrock  | DFD 1   | DFD 1    | bedr     |
| Rock type                      | hyalo.-bre.         | hyalo.-ss           | breccia   | breccia  | breccia | lava     | breccia | breccia  | 1        |
| Phenocryst<br>(mpheno.): %     | Ol: 6.0             | Ol: 5.0, Opx:<br>tr | Ol: 20.2% | Ol: 20.3 | Ol:19.2 | Ol: 36.3 | Ol:16.5 | Ol: 27.5 | Ol: 34.7 |
| Groundmass<br>texture          | glassy<br>(altered) | glassy<br>(altered) | HO        | HO       | HO      | IS       | HO      | HO       | IS       |
| Bulk rock chemistry (wt. %)    |                     |                     |           |          |         |          |         |          |          |
| SiO <sub>2</sub>               | 47.45               | 49.73               | 47.81     | 49.61    | 49.09   | 48.65    | 49.38   | 48.35    | 47.0     |
| TiO <sub>2</sub>               | 1.82                | 1.76                | 1.62      | 1.69     | 1.79    | 1.58     | 1.65    | 1.66     | 1.3      |
| Al <sub>2</sub> O <sub>3</sub> | 10.91               | 10.90               | 9.97      | 11.02    | 10.85   | 9.81     | 10.99   | 9.75     | 8.0      |
| Fe <sub>2</sub> O <sub>3</sub> | 2.32                | 5.52                | 2.83      | 1.10     | 2.83    | 1.79     | 1.03    | 1.40     | 1.6      |
| FeO                            | 13.73               | 6.45                | 11.59     | 11.57    | 10.32   | 11.14    | 11.66   | 11.63    | 11.6     |
| MnO                            | 0.17                | 0.17                | 0.17      | 0.16     | 0.16    | 0.16     | 0.16    | 0.16     | 0.1      |
| MgO                            | 12.61               | 14.41               | 15.90     | 13.89    | 14.22   | 17.47    | 13.73   | 17.16    | 22.3     |
| CaO                            | 9.09                | 8.55                | 8.58      | 9.23     | 9.06    | 8.12     | 9.33    | 8.47     | 6.7      |
| Na <sub>2</sub> O              | 1.83                | 2.20                | 1.59      | 1.80     | 1.84    | 1.69     | 1.79    | 1.56     | 1.3      |
| K <sub>2</sub> O               | 0.28                | 0.26                | 0.25      | 0.28     | 0.39    | 0.23     | 0.22    | 0.29     | 0.1      |
| P <sub>2</sub> O <sub>5</sub>  | 0.17                | 0.16                | 0.15      | 0.17     | 0.17    | 0.14     | 0.14    | 0.15     | 0.1      |
| total                          | 100.38              | 100.10              | 100.45    | 100.53   | 100.70  | 100.76   | 100.08  | 100.59   | 100.7    |
| S (ppm)                        | 190                 | 20                  | 50        | 60       | 260     | 70       | 60      | 30       | 4        |

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| K211-10          | K211-11               | 211-11 mud            | K211-12a         | K211-12b         | K211-13          |
|------------------|-----------------------|-----------------------|------------------|------------------|------------------|
| DFD 1<br>breccia | DFD 2<br>breccia      | DFD 2<br>muddy martix | DFD 2<br>breccia | DFD 2<br>breccia | DFD 1<br>breccia |
| Ol: 18.2         | Cpx: 2.5,<br>Opx: tr) | -                     | (Ol: 2.4)        | (Ol: 1.8)        | Ol: 14.4         |
| HO               | IS                    | -                     | IG               | IS               | IS               |
| 48.32            | 50.41                 | 50.97                 | 50.32            | 50.52            | 49.34            |
| 1.72             | 1.95                  | 2.08                  | 1.86             | 2.01             | 1.81             |
| 9.92             | 12.63                 | 12.80                 | 12.13            | 12.37            | 10.62            |
| 1.46             | 1.29                  | 3.42                  | 0.55             | 6.73             | 0.65             |
| 11.73            | 11.61                 | 7.74                  | 11.10            | 6.69             | 11.68            |
| 0.17             | 0.16                  | 0.17                  | 0.16             | 0.17             | 0.16             |
| 16.96            | 8.58                  | 9.13                  | 9.91             | 9.19             | 14.85            |
| 8.54             | 10.34                 | 9.07                  | 10.06            | 10.40            | 8.71             |
| 1.66             | 2.12                  | 3.00                  | 2.02             | 2.12             | 1.82             |
| 0.29             | 0.35                  | 0.81                  | 0.32             | 0.37             | 0.34             |
| 0.16             | 0.18                  | 0.20                  | 0.17             | 0.19             | 0.18             |
| 100.93           | 99.62                 | 99.39                 | 98.59            | 100.76           | 100.15           |
| 70               | 90                    | 1030                  | 20               | 32               | 70               |

**Table DR 1-C. Glass analyses, Kaiko dives K210 and K211.**

Analyses by electron microprobe by Michelle Coombs, at USGS Menlo Park. Each analysis is average of 3 points

A. Glass rinds on pillow fragments, distal block (dive K211), South Kona slide complex

| Sample                         | 211-3a | 211-6a | 211-6b | 211-9  | 211-13 |
|--------------------------------|--------|--------|--------|--------|--------|
| (wt. %)                        |        |        |        |        |        |
| SiO <sub>2</sub>               | 52.04  | 51.77  | 52.03  | 52.50  | 52.22  |
| TiO <sub>2</sub>               | 2.19   | 2.55   | 2.23   | 2.09   | 2.24   |
| Al <sub>2</sub> O <sub>3</sub> | 14.42  | 14.19  | 14.36  | 14.49  | 14.20  |
| FeTO <sub>5</sub>              | 10.18  | 10.38  | 10.17  | 10.06  | 10.04  |
| MnO                            | 0.16   | 0.16   | 0.16   | 0.16   | 0.17   |
| MgO                            | 7.08   | 6.70   | 6.40   | 6.96   | 6.88   |
| CaO                            | 11.46  | 11.10  | 11.84  | 10.96  | 10.89  |
| Na <sub>2</sub> O              | 2.25   | 2.41   | 2.18   | 2.38   | 2.33   |
| K <sub>2</sub> O               | 0.31   | 0.47   | 0.32   | 0.31   | 0.40   |
| P <sub>2</sub> O <sub>5</sub>  | 0.20   | 0.28   | 0.21   | 0.20   | 0.24   |
| Total                          | 100.29 | 100.01 | 99.90  | 100.11 | 99.61  |
| S (ppm)                        | 60     | 32     | 9      | 29     | 88     |

## B. Small glass fragments in hyaloclastite breccia (K210-R8), scarp of mid-slope bench, South Kona

| Sample                         | K210-R8-1 | K210-R8-2 | K210-R8-3 | K210-R8-4 | K210-R8-5 | K210-R8-6 | K210-R8-7 | K210-R8-8 | K210-R8 |
|--------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|---------|
|                                | 3.00      | 3.00      | 3.00      | 3.00      | 3.00      | 3.00      | 3.00      | 3.00      | 3.      |
| SiO <sub>2</sub>               | 51.22     | 51.25     | 51.32     | 51.40     | 51.16     | 51.34     | 51.40     | 51.49     | 51.     |
| TiO <sub>2</sub>               | 2.08      | 2.08      | 2.09      | 2.05      | 2.09      | 1.99      | 2.02      | 2.02      | 2.      |
| Al <sub>2</sub> O <sub>3</sub> | 13.32     | 13.28     | 13.35     | 13.39     | 13.29     | 13.37     | 13.32     | 13.49     | 13.     |
| FeTO <sub>5</sub>              | 11.21     | 11.29     | 11.20     | 11.30     | 11.25     | 11.20     | 11.28     | 11.23     | 11.     |
| MnO                            | 0.18      | 0.17      | 0.17      | 0.18      | 0.18      | 0.17      | 0.17      | 0.19      | 0.      |
| MgO                            | 9.08      | 9.15      | 9.11      | 8.94      | 9.26      | 9.01      | 9.12      | 8.64      | 8.      |
| CaO                            | 10.31     | 10.27     | 10.27     | 10.33     | 10.24     | 10.27     | 10.31     | 10.45     | 10.     |
| Na <sub>2</sub> O              | 2.18      | 2.17      | 2.18      | 2.22      | 2.17      | 2.18      | 2.18      | 2.22      | 2.      |
| K <sub>2</sub> O               | 0.30      | 0.30      | 0.31      | 0.32      | 0.31      | 0.31      | 0.30      | 0.31      | 0.      |
| P <sub>2</sub> O <sub>5</sub>  | 0.20      | 0.20      | 0.21      | 0.18      | 0.19      | 0.20      | 0.18      | 0.19      | 0.      |
| SO <sub>3</sub>                | 0.10      | 0.10      | 0.10      | 0.08      | 0.10      | 0.10      | 0.10      | 0.08      | 0.      |
| Cl                             | 0.01      | 0.01      | 0.01      | 0.00      | 0.01      | 0.01      | 0.00      | 0.01      | 0.      |
| Total                          | 100.20    | 100.25    | 100.30    | 100.39    | 100.24    | 100.16    | 100.37    | 100.31    | 100.    |
| S (ppm)                        | 398       | 380       | 388       | 315       | 391       | 401       | 399       | 326       | 2       |
| Cl (ppm)                       | 77        | 113       | 103       | 37        | 93        | 70        | 43        | 50        |         |

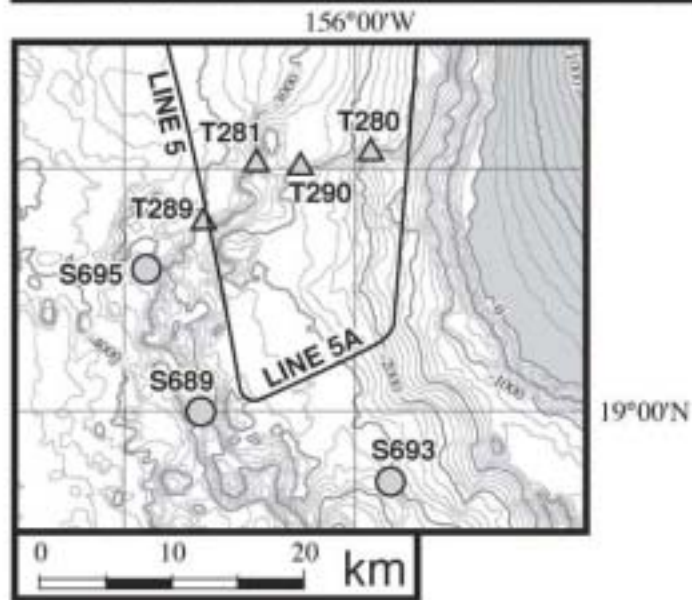
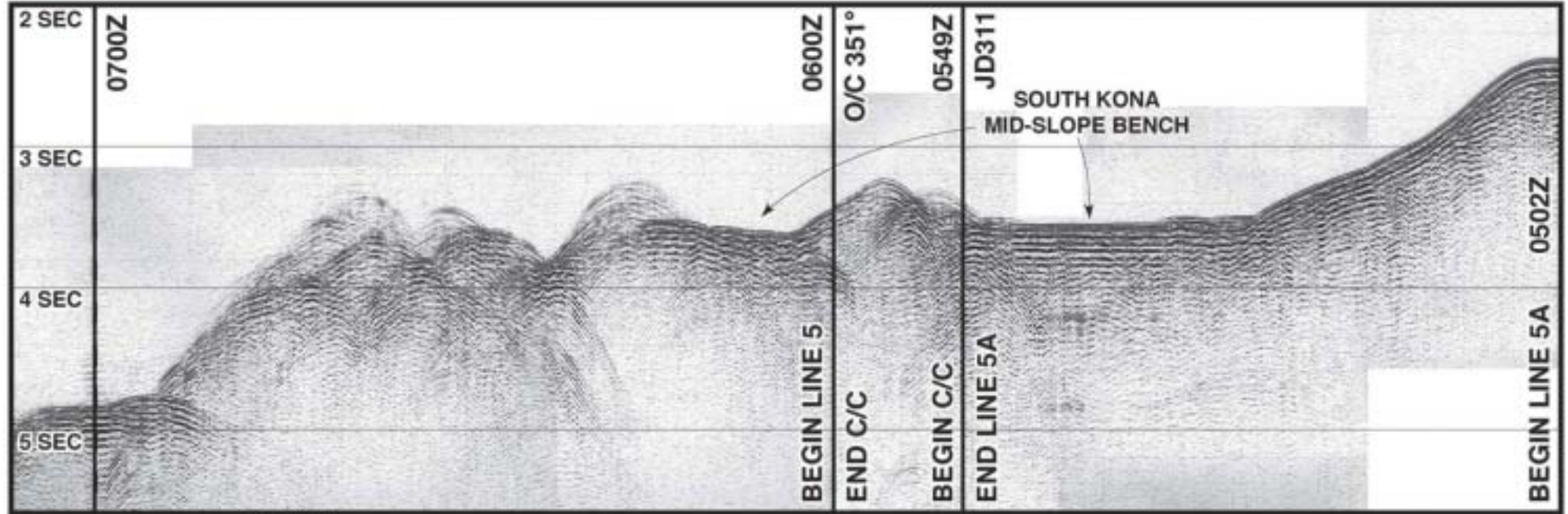


| K210-R8-12 | K210-R8-13 | K210-R8-14 | K210-R8-15 | K210-R8-16 | K210-R8-17 | K210-R8-18 | K210-R8-19 | K210-R8-20 | K210-R8-21 |
|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|
| 3.00       | 3.00       | 3.00       | 3.00       | 3.00       | 3.00       | 3.00       | 3.00       | 3.00       | 3.00       |
| 51.04      | 50.99      | 51.12      | 51.06      | 50.97      | 51.57      | 51.21      | 51.47      | 51.08      | 51.08      |
| 2.07       | 2.07       | 2.11       | 1.98       | 2.00       | 2.09       | 2.07       | 2.24       | 2.03       | 2.03       |
| 13.21      | 13.28      | 13.42      | 13.34      | 13.34      | 13.78      | 13.40      | 13.71      | 13.25      | 13.25      |
| 11.30      | 11.47      | 11.40      | 11.39      | 11.25      | 11.20      | 11.42      | 11.33      | 11.38      | 11.38      |
| 0.18       | 0.18       | 0.17       | 0.16       | 0.18       | 0.17       | 0.20       | 0.18       | 0.20       | 0.20       |
| 9.35       | 9.00       | 8.73       | 9.30       | 9.27       | 8.13       | 8.86       | 7.83       | 9.40       | 9.40       |
| 10.23      | 10.33      | 10.40      | 10.28      | 10.28      | 10.65      | 10.36      | 10.44      | 10.27      | 10.27      |
| 2.17       | 2.16       | 2.18       | 2.12       | 2.14       | 2.19       | 2.16       | 2.29       | 2.15       | 2.15       |
| 0.31       | 0.31       | 0.31       | 0.30       | 0.31       | 0.31       | 0.30       | 0.35       | 0.30       | 0.30       |
| 0.18       | 0.18       | 0.18       | 0.18       | 0.17       | 0.19       | 0.18       | 0.20       | 0.18       | 0.18       |
| 0.11       | 0.18       | 0.29       | 0.11       | 0.11       | 0.11       | 0.10       | 0.14       | 0.09       | 0.09       |
| 0.01       | 0.01       | 0.00       | 0.01       | 0.01       | 0.01       | 0.00       | 0.01       | 0.01       | 0.01       |
| 100.14     | 100.16     | 100.30     | 100.22     | 100.03     | 100.38     | 100.26     | 100.17     | 100.32     | 100.32     |
| 439        | 710        | 1143       | 439        | 458        | 442        | 402        | 569        | 342        | 342        |
| 113        | 110        | 43         | 77         | 53         | 107        | 47         | 93         | 110        | 110        |

Field of Kilauea glass compositions from data  
 Petrology of submarine lavas from Kilauea'

| <u>K210-R8-24</u> | <u>K210-R8-25</u> |
|-------------------|-------------------|
| 3.00              | 3.00              |
| 50.85             | 51.55             |
| 1.97              | 2.13              |
| 12.98             | 13.80             |
| 11.47             | 11.18             |
| 0.17              | 0.16              |
| 10.20             | 8.07              |
| 10.07             | 10.74             |
| 2.09              | 2.21              |
| 0.29              | 0.31              |
| 0.17              | 0.20              |
| 0.14              | 0.08              |
| 0.01              | 0.01              |
| 100.40            | 100.42            |
| 553               | 328               |
| 90                | 60                |

e, J.E. Dixon, and W.B. F  
nal of Petrology, v. 36, p.



**Figure DR 1.** Two-channel seismic-reflection profile (unprocessed paper record) across South Kona bench. Line 5A shows flat-lying sedimentary fill behind lip of bench, with two-way travel time of ~0.5 seconds, equivalent to sediment thickness of at least several hundred meters. Seismic system (2,600 cm<sup>2</sup> airgun source) described in: Normark, W.P., Lipman, P.W., Wilson, J.B., Jacobs, C.L., Johnson, D.P., and Gutmacher, C.E., 1987, Preliminary cruise report Hawaiian GLORIA Leg 2, F6-86-HW, November 1986: U.S. Geological Survey Open-File Report 87-298, 34 p.

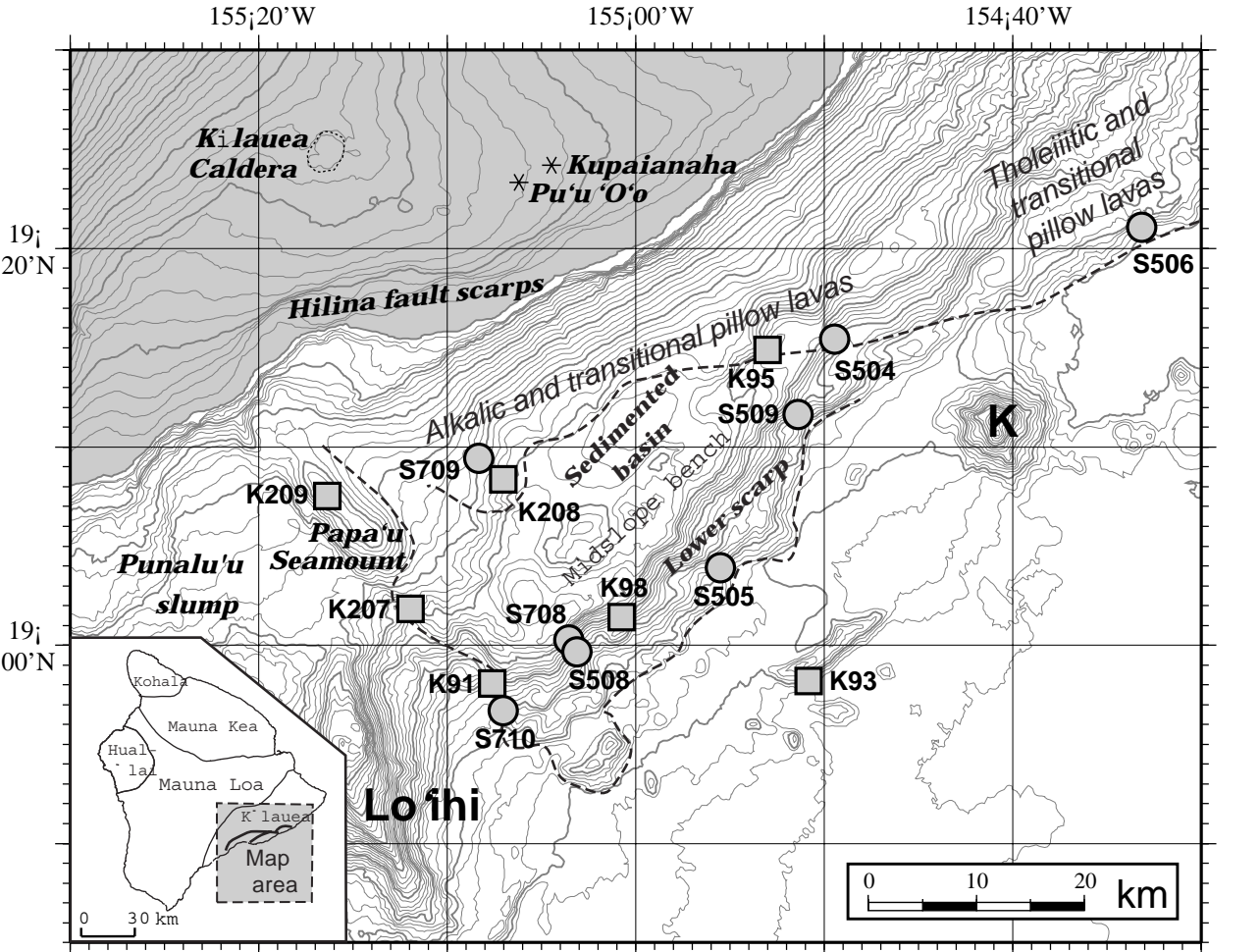


Figure DR-2. Map of the south flank of Kilauea volcano, showing dive locations and boundaries between major lithologic units. Dashed line, approximate boundary between volcaniclastic rocks of midslope bench and lower scarp, versus overlying pillow basalts. K large Cretaceous seamount. Dive sites: squares, ROV *Kaiko*; circles, *Shinkai 6500*. Contour interval, 100 m.