GP43A-0791 A Refined ~4.5 Ma Paleomagnetic Pole from Basaltic Lava Flow Sequences on Kauai, Hawaii

Scott Bogue and Yiming Zhang*
Occidental College Los Angeles CA bogue@oxy.edu
(* Zhang now at Univ. of California, Berkeley CA)

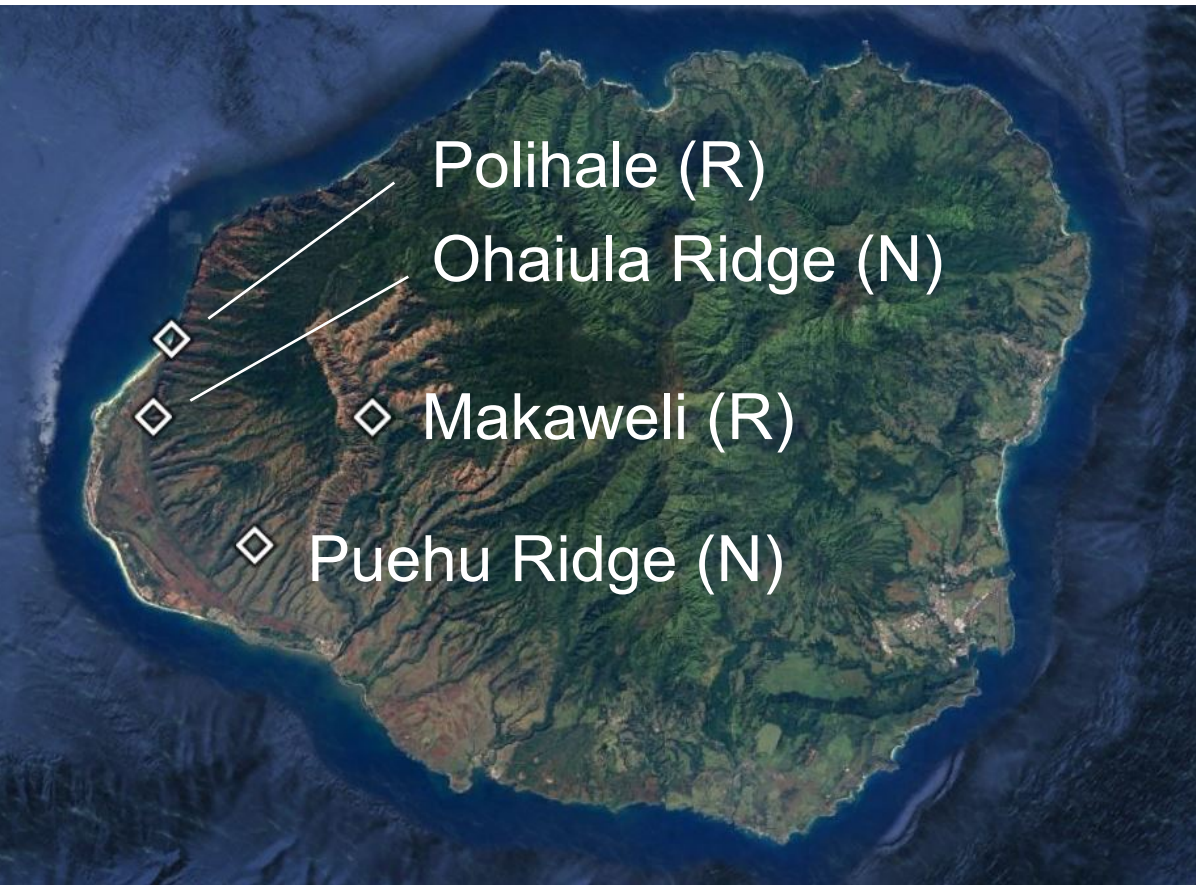OXY Occidental College | AGU 100 ADVANCING EARTH AND SPACE SCIENCE

INTRODUCTION

Motivation: Constrain youngest part of Pacific Plate APW with ~4.5 Ma paleomagnetic pole.

Background: 40 normally magnetized and 24 reversely magnetized flows collected in 1961 and 1967 by USGS; 60% of site-mean directions reported by Doell (JGR 1972) were NRM.

This study: Perform modern paleomagnetic analysis of Doell (1972) samples and combine results with more recent published data from Kauai (Bogue 1984).

SAMPLE LOCALITIES

Polihale (R)
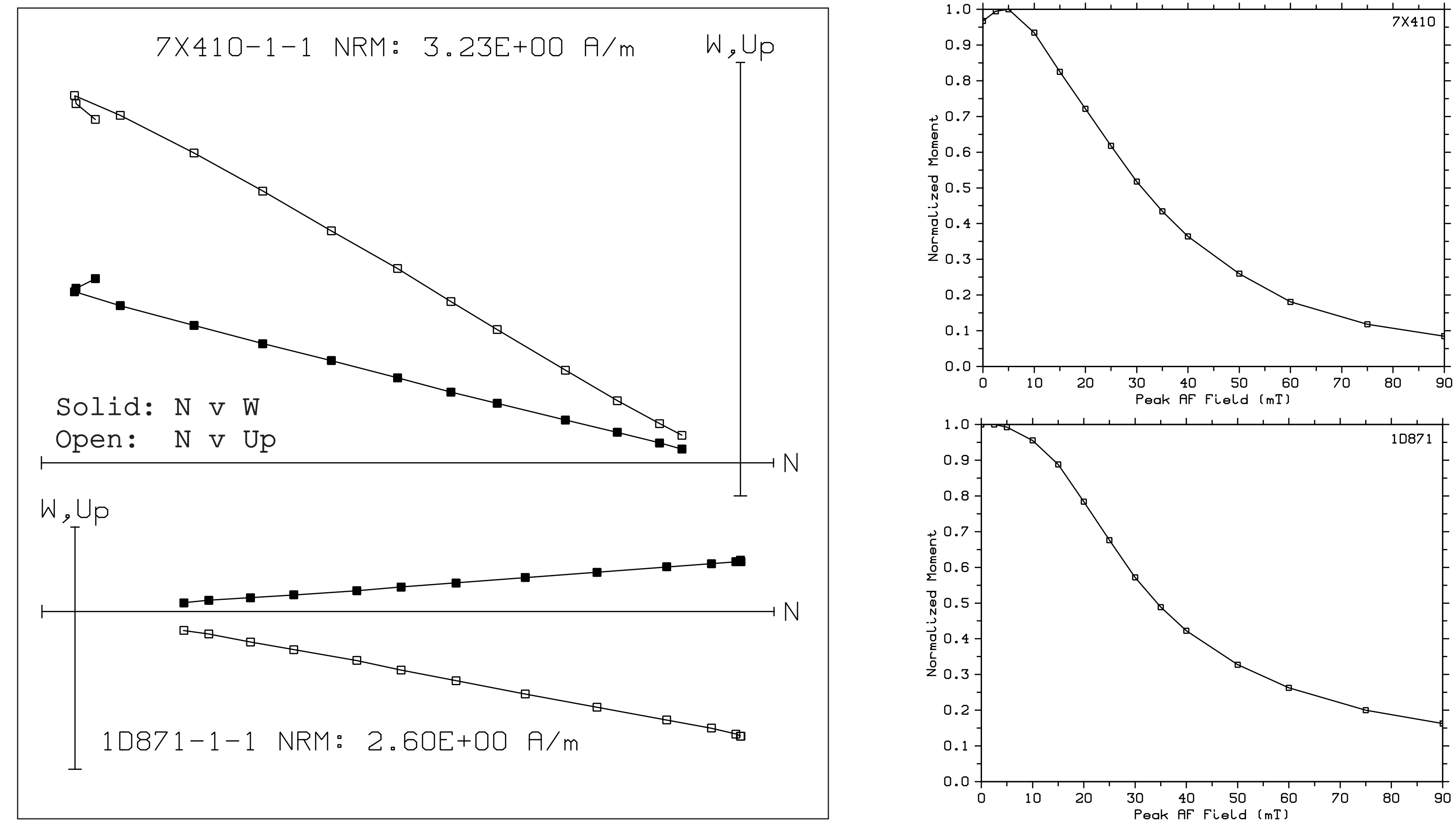Ohaiula Ridge (N)
Makaweli (R)
Puehu Ridge (N)

Sampling localities for ~4.5 My old lava flows on Kauai, Hawaii (200.3 E, 22.1 N)

Polihale N=31 reverse (Bogue, JGR 1984)
Ohaiula Ridge N=28 normal (Bogue, JGR 1984)
Puehu Ridge N=40 normal (Doell, JGR 1972)
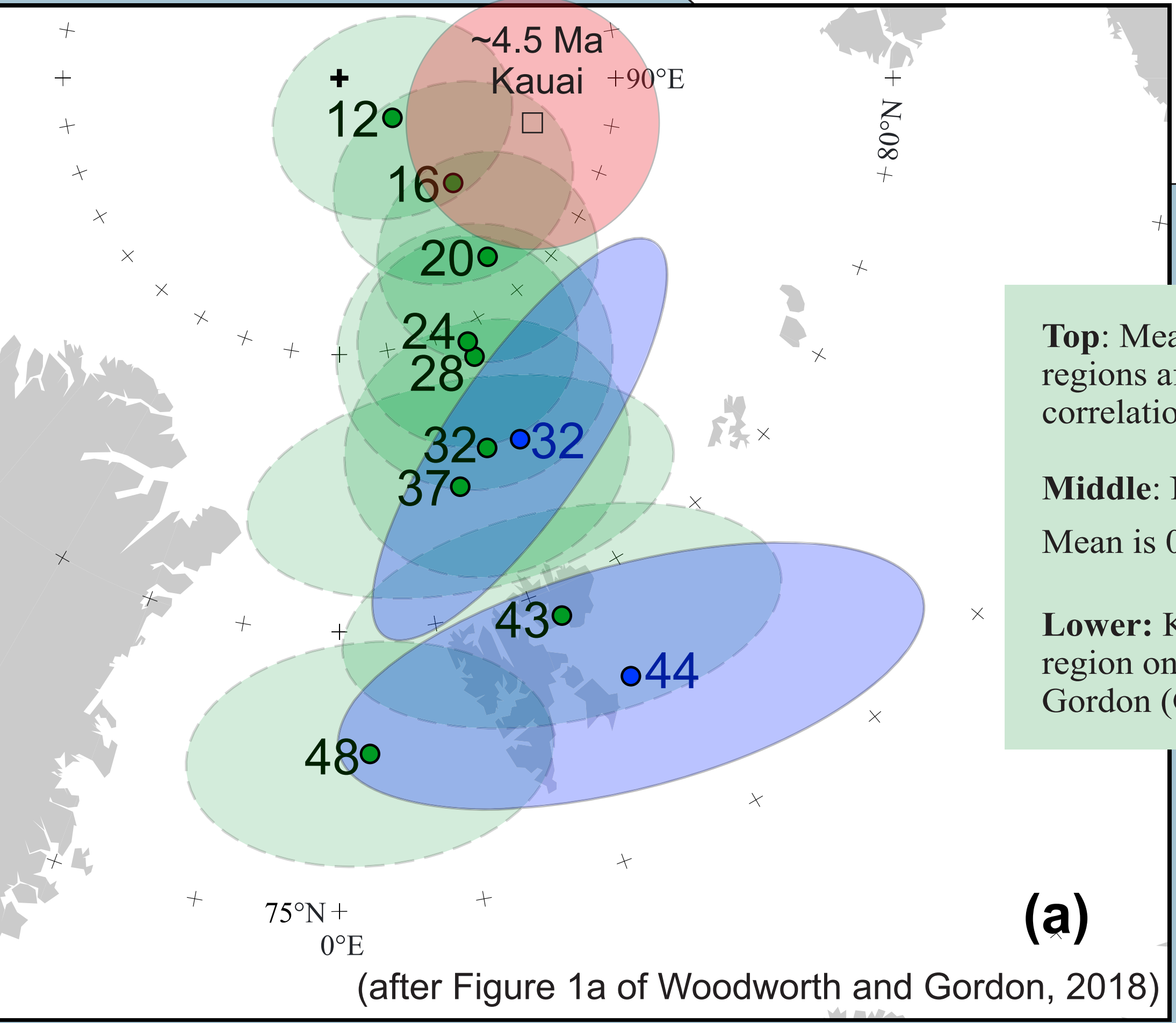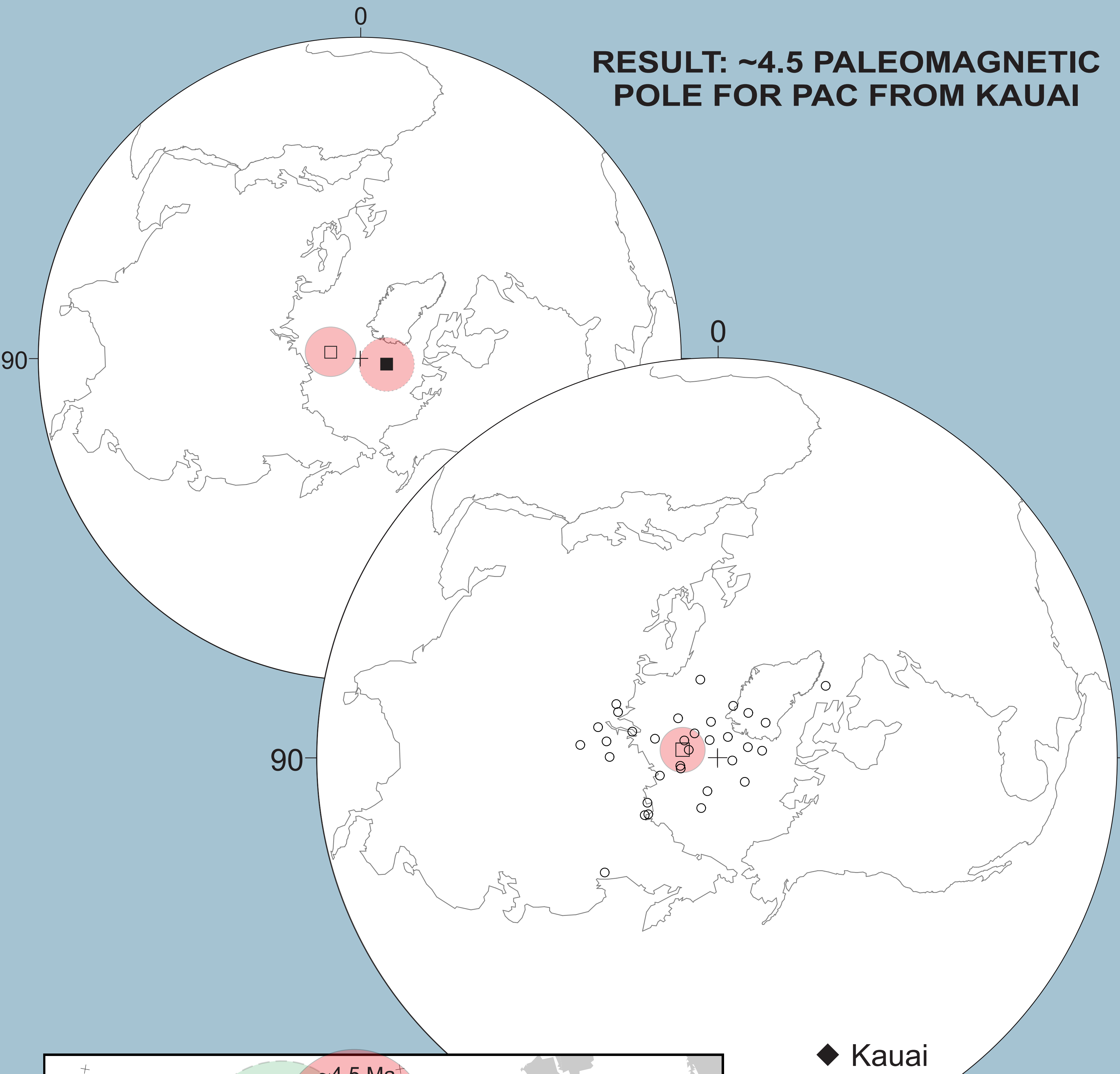Makaweli N=24 reverse (Doell, JGR 1972)

Superposed lava flows at the Polihale locality.

REPRESENTATIVE SAMPLE BEHAVIOR DURING AF DEMAG

7X410-1-1 NRM: 3.23E+00 A/m   W,Up

Solid: N v W
Open: N v Up

1D871-1-1 NRM: 2.60E+00 A/m

All samples from Doell (1972) collection subjected to 13-step AF demagnetization to 90 mT.

Almost all samples decayed linearly to origin after removal of small secondary component (VRM or IRM).

RESULT: ~4.5 PALEOMAGNETIC POLE FOR PAC FROM KAUAI

◆ Kauai

~4.5 Ma Kauai +90°E

12
16
20
24
28
32   32
37
43   44
48

Top: Mean N and R VGPs and 95% confidence regions after "lumping" to minimize serial correlation (Open: upper; solid: lower).

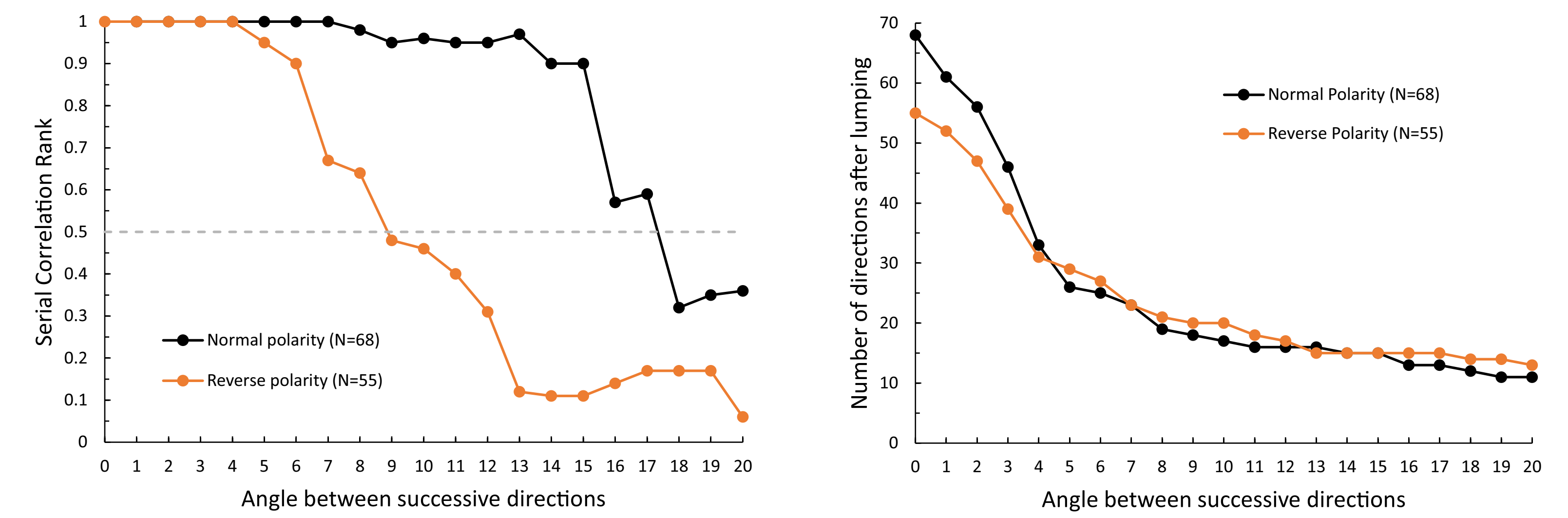**Middle**: N and inverted R VGPs after "lumping". Mean is 077.3E 82.8N N=33 K=31.8 α₉₅=4.5

Mean is 077.3E 82.8N N=33 K=31.8 α_{95}=4.5

Lower: Kauai ~4.5 Ma pole and 95% confidence region on Pacific APW path of Woodsworth and Gordon (GRL, 2018).

(a)
(after Figure 1a of Woodworth and Gordon, 2018)

COMBINING FLOW MEANS TO MINIMIZE SERIAL CORRELATION

1. Set minimum angle (α) between independent observations of ancient field direction.
2. Proceed through list of successive flow mean direction pairs until two are α apart.
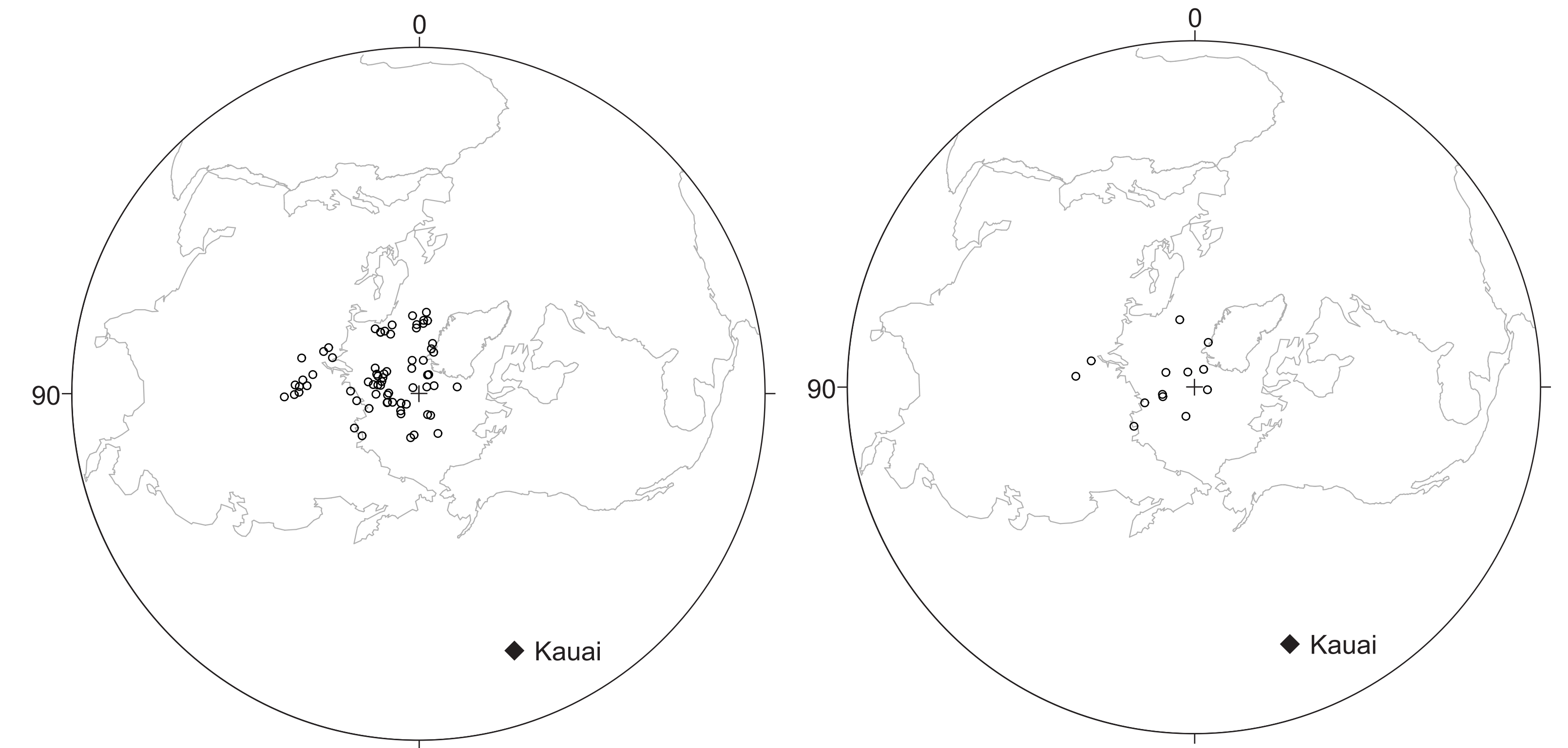3. Average directions of preceding flows.
4. Repeat.

Following Watson and Beran (JGR 1967), calculate sum L of cosines of angles between successive "lumped" directions, and compare to 5000 randomized versions of the list. L will be large for serially-correlated directions.

A "serial correlation rank" of 0.75 means that Ls for 75% of randomized lists are smaller than the observed L (suggesting substantial serial correlation).

Serial correlation rank drops to ~0.5 at α=16° for normal polarity flows (left plot). Lumping reduces 68 flow mean directions to 13 independent field observations of the ancient field direction (right plot). For reverse polarity flows the serial correlation rank drops to ~0.5 at α=10°, yielding 20 field directions from 55 flow mean directions.

EFFECT OF "LUMPING" ON NORMAL POLARITY DIRECTIONS

◆ Kauai   ◆ Kauai

Miminizing serial correlation of normal polarity directions changes mean by 2.4°. Estimated scatter decreases slightly (k=41.6 to k=45.9).

Radius of 95% confidence region is much larger on the "lumped" data (2.7° vs. 6.2°) with the decrease in N (from 68 to 13).

CONCLUSIONS

Average difference in site-mean directions of Doell (1972) and this study: 2.2° (Makaweli) and 2.3° (Puehu R.). Locality means changed by 1.9° (Makaweli) and 1.0° (Puehu Ridge).

"Lumping" to minimize serial correlation produces 33 independent observations of the ~4.5 Ma field from 123 flow mean directions.

Mean normal and reverse poles are nearly antiparallel (179°). The grand mean pole lies 7.2° from the spin axis.

Angular standard deviation of VGPs (14.3° about mean; 15.9° about spin axis) is similar to that found in other analyses of Hawaii lava flow data.