Documentation and digital files in support of:

"Aftershock regions of Aleutian–Alaska megathrust earthquakes, 1938–2021"

PART B[1]: Digitization of previously published aftershock regions of the Aleutian–Alaska subduction zone

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Attribution: If you use these digital files, please cite *Tape and Lomax* (2022).

Overview

This collection includes digitized boundaries of aftershock regions derived from maps published in three studies: *Sykes* (1971), *McCann et al.* (1979), and *Sykes et al.* (1981). We also include documentation for how the published maps were georeferenced and how the boundaries were digitized.

The digitized boundaries of aftershock regions from the study of *Tape and Lomax* (2022) are provided within the online supplement for that publication.

B1 Choice of maps and aftershock regions

The study of *Tape and Lomax* (2022) builds upon previous studies that identified aftershock regions of major earthquakes along the southern Alaska plate boundary. Three of these maps are shown in Figure B1. The map of *Sykes* (1971) characterizes regions for 26 earthquakes:

- 6 major earthquakes depicted by light shaded regions (west to east: 1965, 1957, 1938, 1964, 1958, 1949)

- 11 magnitude 7.0–7.5 earthquakes depicted by dark shaded regions (west to east: 1940 7.1/7.2, 1965 7.5, 1929 7.3/7.0, 1929 8.6, 1960 7.0, 1957 7.0, 1946 7.4, 1948 7.5, 1951 7.1, 1957 7.1, 1970 7.0)

- 9 magnitude 7.0–7.5 earthquakes depicted as shaded small circles (west to east: 1925 7.2, 1953 7.1, 1926 7.1, 1965 7.1, 1940 7.1, 1923 7.1, 1964 7.1, 1946 7.2, 1927 7.1)

The map of *McCann et al.* (1979) contains 9 aftershock regions. The map of *Sykes et al.* (1981) contains 10 aftershock regions, including for 1979-02-28 M_{w} 7.5.

We chose the following aftershock region boundaries to digitize:

- *Sykes* (1971): 6 major earthquakes, 1946, and 1948

- *McCann et al.* (1979): only 2: 1957 and 1958, which differ from those in *Sykes et al.* (1981)

- *Sykes et al.* (1981): all 10

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[1]Part A is published in a separate Zenodo collection. Parts B, C, and D are published together in this Zenodo collection.

B2 Georeferencing

The maps we used were extracted from the pdf files of each manuscript. Technical notes on the georeferencing procedure are provided in the document `georeferencing_workflow.pdf`. Here we summarize the main steps.

1. Load map image (e.g., Figure B1a) into ArcGIS Pro.

2. Load digital coastlines of *Wessel and Smith* (1996), available at `https://www.ngdc.noaa.gov/mgg/shorelines/`.

   The georeferencing is performed using the ellipsoid NAD 1927 Alaska Albers.

3. Manually choose control points in the map image. We chose points that could most easily be located in the digital coastline file, such as endpoint of islands and small bays. We also chose points that span the entire map image (east, west, north, south). As the control points are chosen, ArcGIS Pro iteratively improves the distortion of the map image to the known control points.

   Figure B3 shows the control points used for each of the three maps. Figures B4 and B5 shows zoom-ins on these maps for two selected regions: Cook Inlet and the 1957 earthquake.

B3 Digitization of boundaries of aftershock regions

Section B1 lists the boundaries that we digitized. Technical notes on the digitization procedure are provided in the document `digitizing_boundaries_workflow.pdf`. Figure B6 shows several examples of digitization points superimposed on the georeferenced published map images.

B4 Description of files

1. `TL2022_ZB_boundaries.pdf` (this file)

2. `georeferencing_workflow.pdf` (see above)

3. `digitizing_boundaries_workflow.pdf` (see above)

4. `ZB_sykes1971_mccann1979_sykes1981.zip`
   Zipped set of ascii files for plotting in GMT (*Wessel and Smith*, 1991) or a comparable scripting program.

5. `Tape_GEOREFERENCE_10.zip`
   Complete ArcGIS Pro project, including shape files for use in ArcGIS Pro or QGIS.
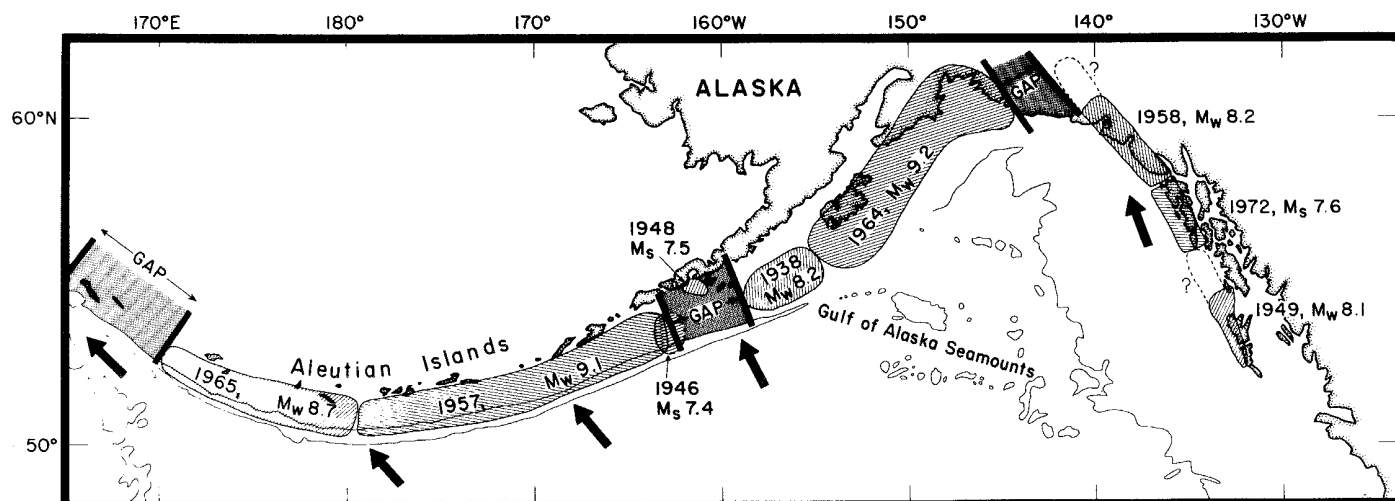
References

McCann, W. R., S. P. Nishenko, L. R. Sykes, and J. Krause, Seismic gaps and plate tectonics: Seismic potential for major boundaries, *Pure App. Geophys.*, *117*, 1082–1147, 1979.

Sykes, L. R., Aftershock zones of great earthquakes, seismicity gaps, and earthquake prediction for Alaska and the Aleutians, *J. Geophys. Res.*, *76*(32), 8021–8041, 1971.

Sykes, L. R., J. B. Kisslinger, L. House, J. N. Davies, and K. H. Jacob, Rupture zones and repeat times of great earthquakes along the Alaska–Aleutian arc, 1784–1980, in *Earthquake Prediction: An International Review, Maurice Ewing Series*, vol. 4, edited by D. W. Simpson and P. G. Richards, pp. 73–80, Am. Geophys. Un., Washington, D.C., 1981.

Tape, C., and A. Lomax, Aftershock regions of Aleutian–Alaska megathrust earthquakes, 1938–2021, *J. Geophys. Res. Solid Earth* (in preparation), 2022.

Wessel, P., and W. H. F. Smith, Free software helps map and display data, *Eos Trans. Am. Geophys. Un.*, *72*(41), 441 ff., 1991.

Wessel, P., and W. H. F. Smith, A global, self-consistent, hierarchical, high-resolution shoreline database, *J. Geophys. Res.*, *101*(B4), 8741–8743, doi:10.1029/96JB00104, 1996.

(a) *Sykes* (1971), Figure 4
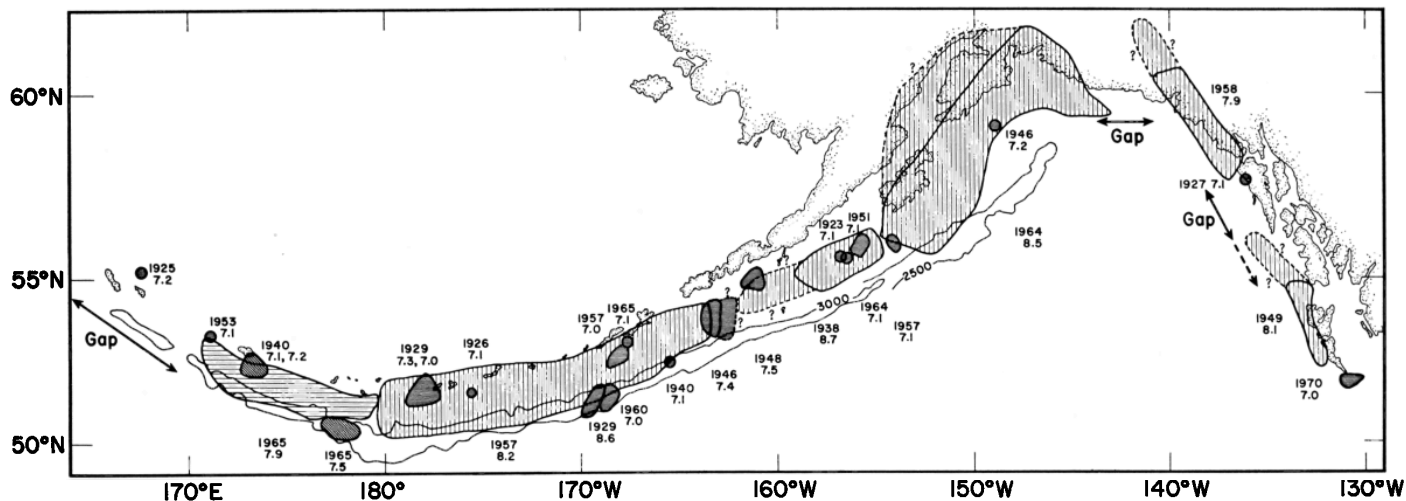
(b) *McCann et al.* (1979), Figure 5

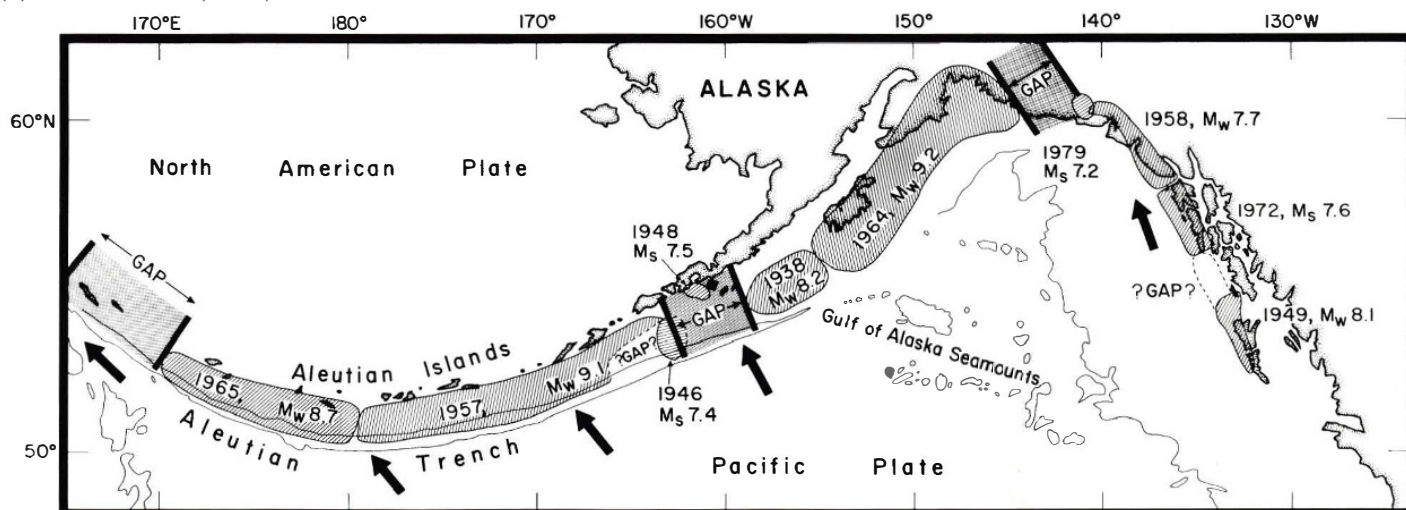

(c) *Sykes et al.* (1981), Figure 2

Figure B1: Aftershock regions from three published studies. We digitized the boundaries of these regions after georeferencing these maps in ArcGIS Pro.
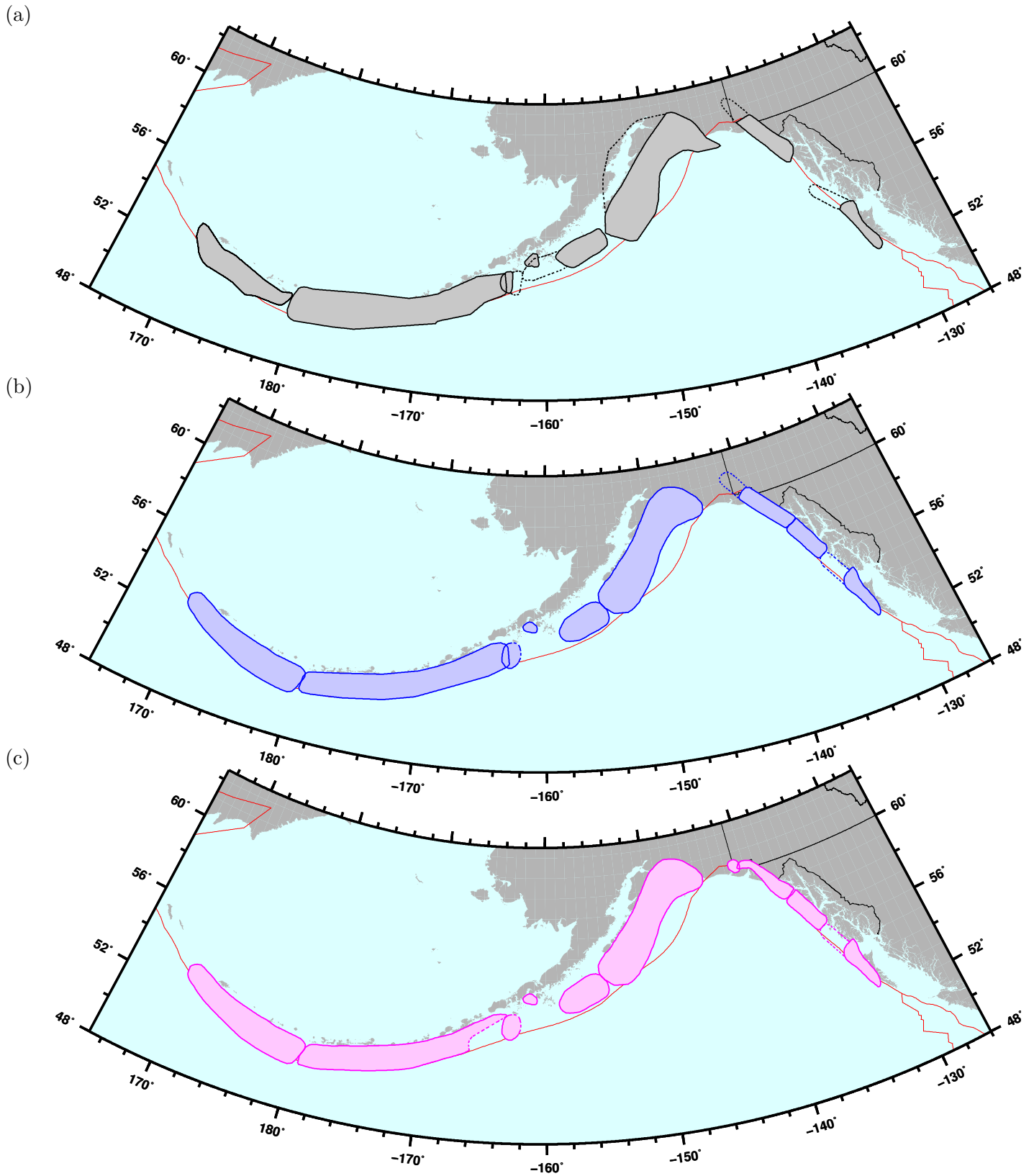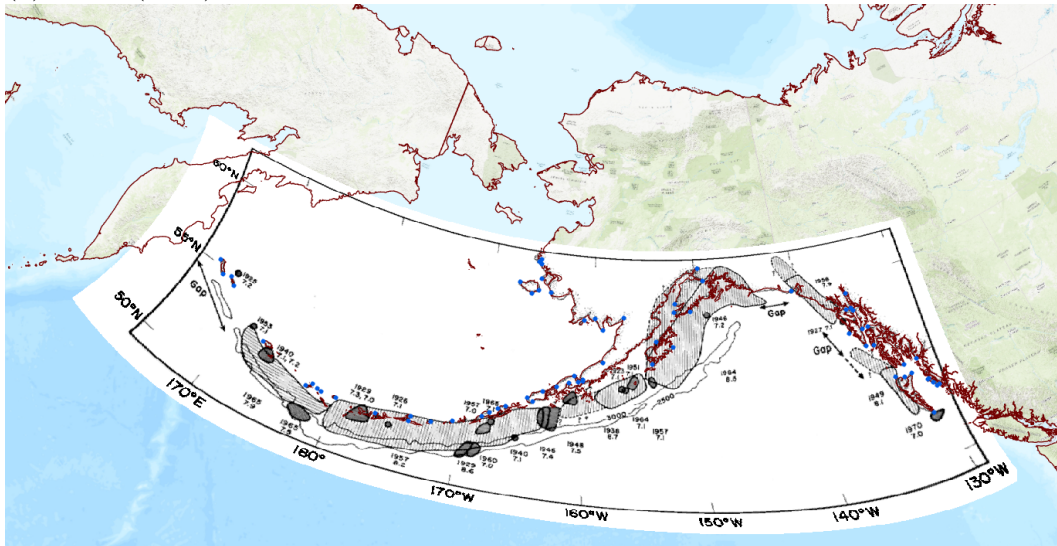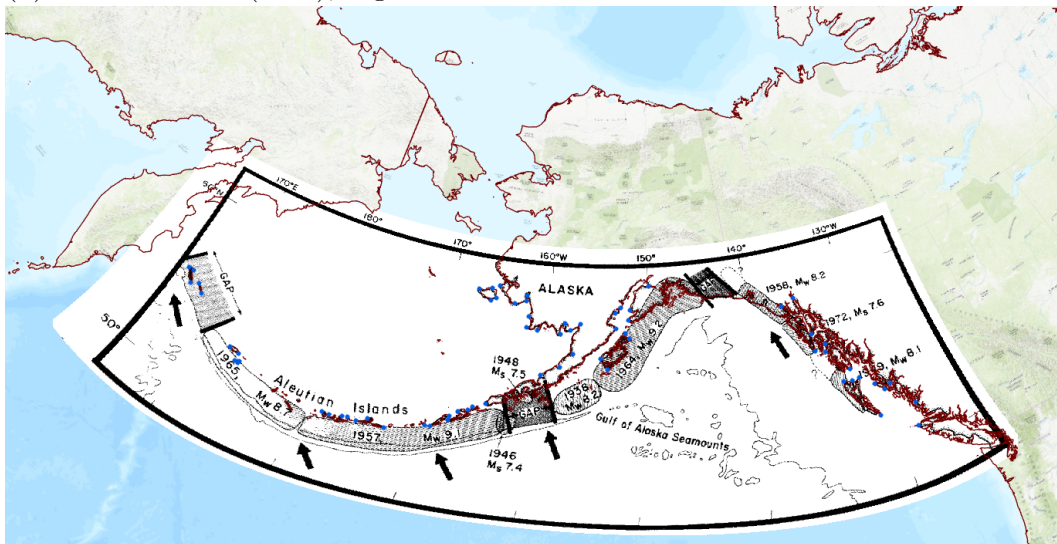
(a)

(b)

(c)

Figure B2: Aftershock zones of major earthquakes along the Aleutian–Alaska subduction zone. (See also Figure 1 of *Tape and Lomax* (2022).) (a) *Sykes* (1971). (b) *McCann et al.* (1979). (c) *Sykes et al.* (1981).

(a) *Sykes* (1971), Figure 4

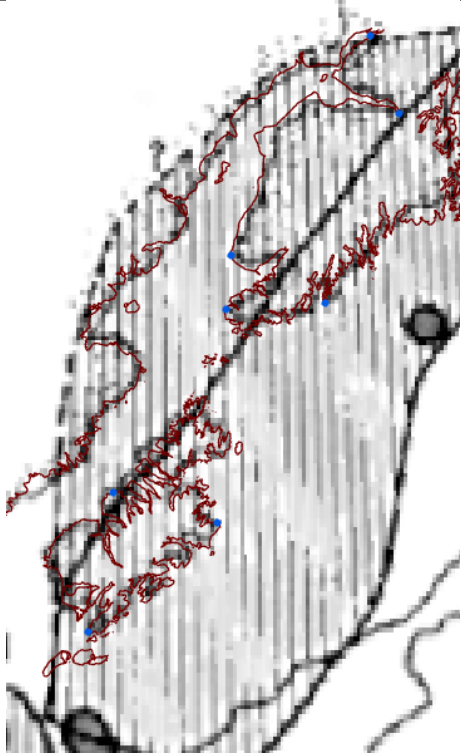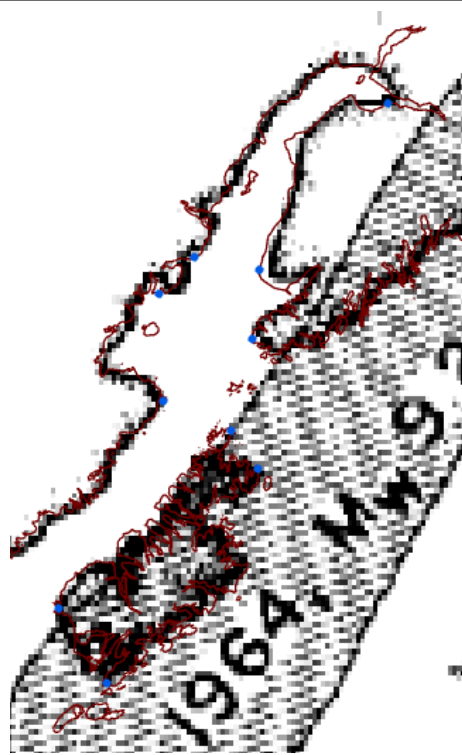(b) *McCann et al.* (1979), Figure 5

(c) *Sykes* (1971), Figure 2
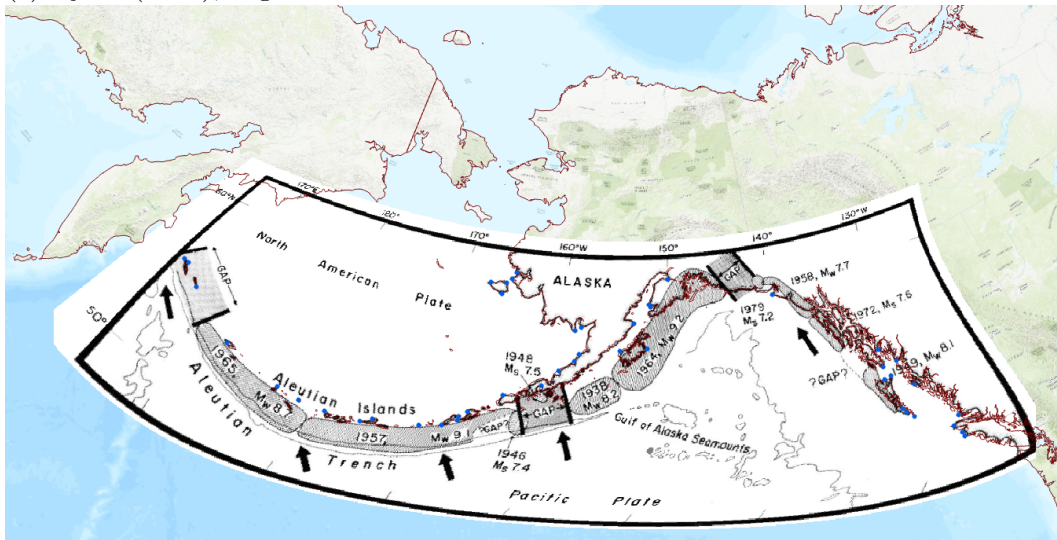
Figure B3: Zoomed-out views of the georefernecing, showing the selection of control points (blue dots), as well as the alignment of the digital coastlines with the features in the published maps.
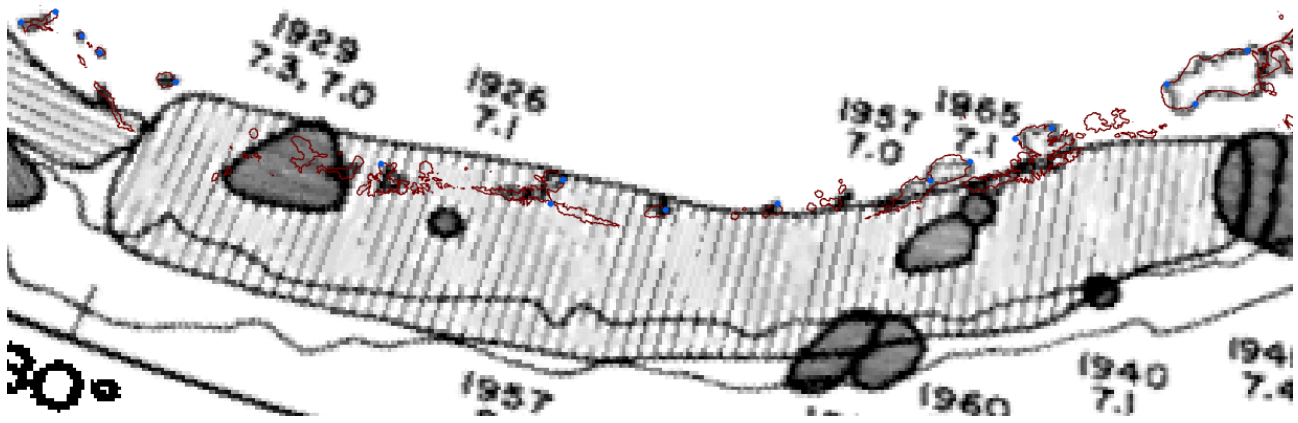
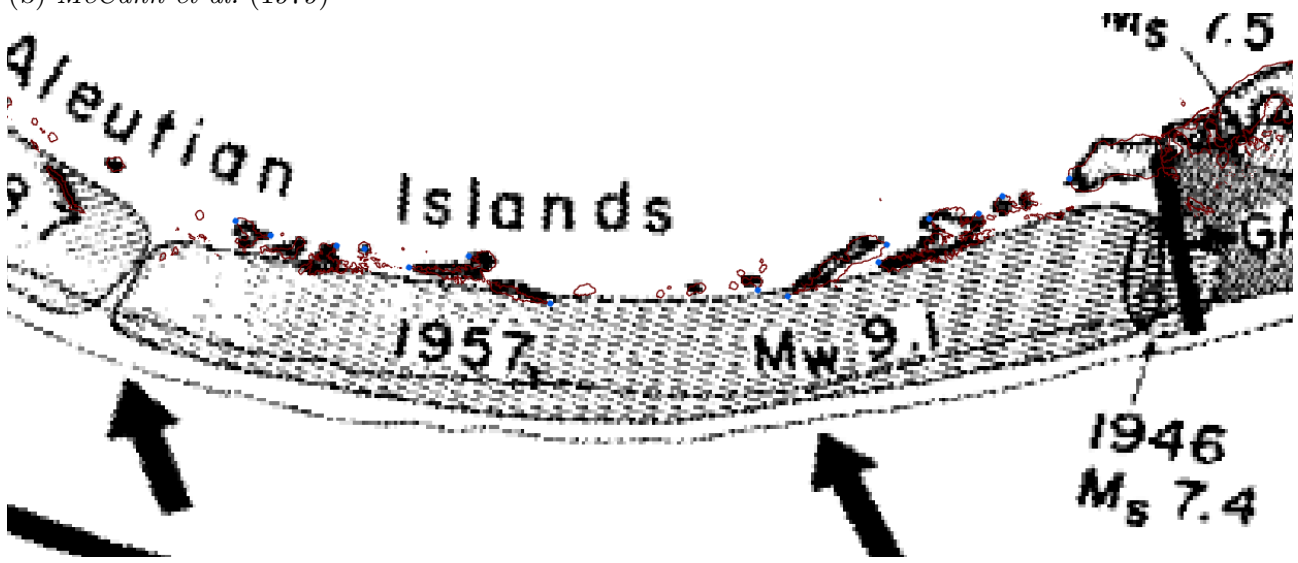(a) *Sykes* (1971)   (b) *McCann et al.* (1979)   (c) *Sykes* (1971)

Figure B4: Examples of georeferencing for the region of Cook Inlet and Kodiak Island. Blue dots are the control points used for georeferencing.

(a) *Sykes* (1971)

(b) *McCann et al.* (1979)
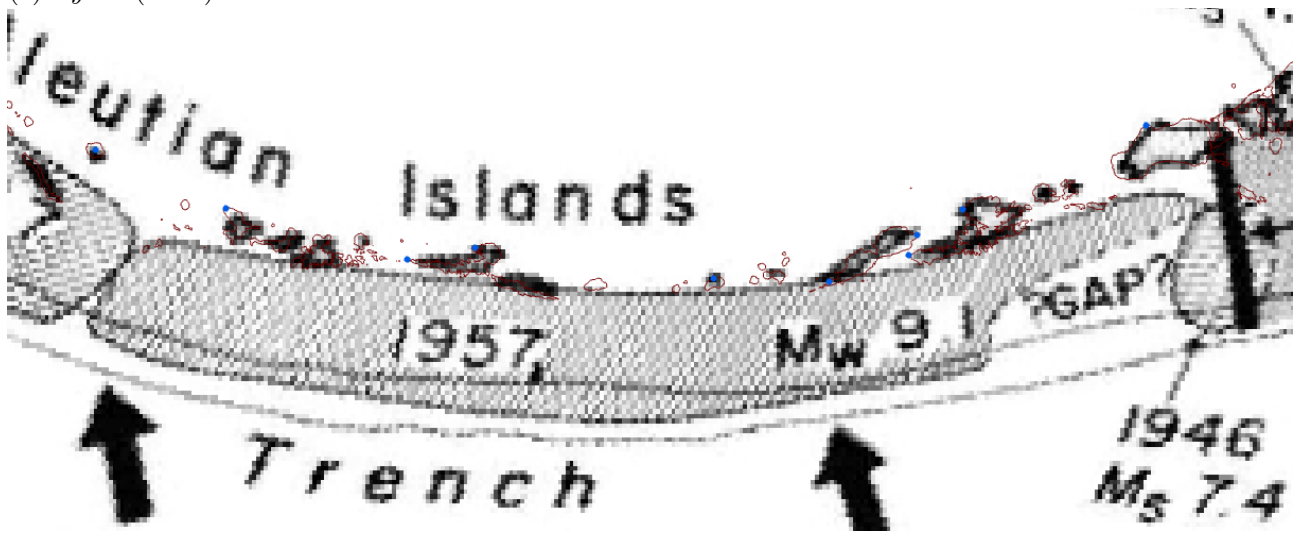

(c) *Sykes* (1971)

Figure B5: Examples of georeferencing for the region of the 1957 earthquake. Blue dots are the control points used for georeferencing.
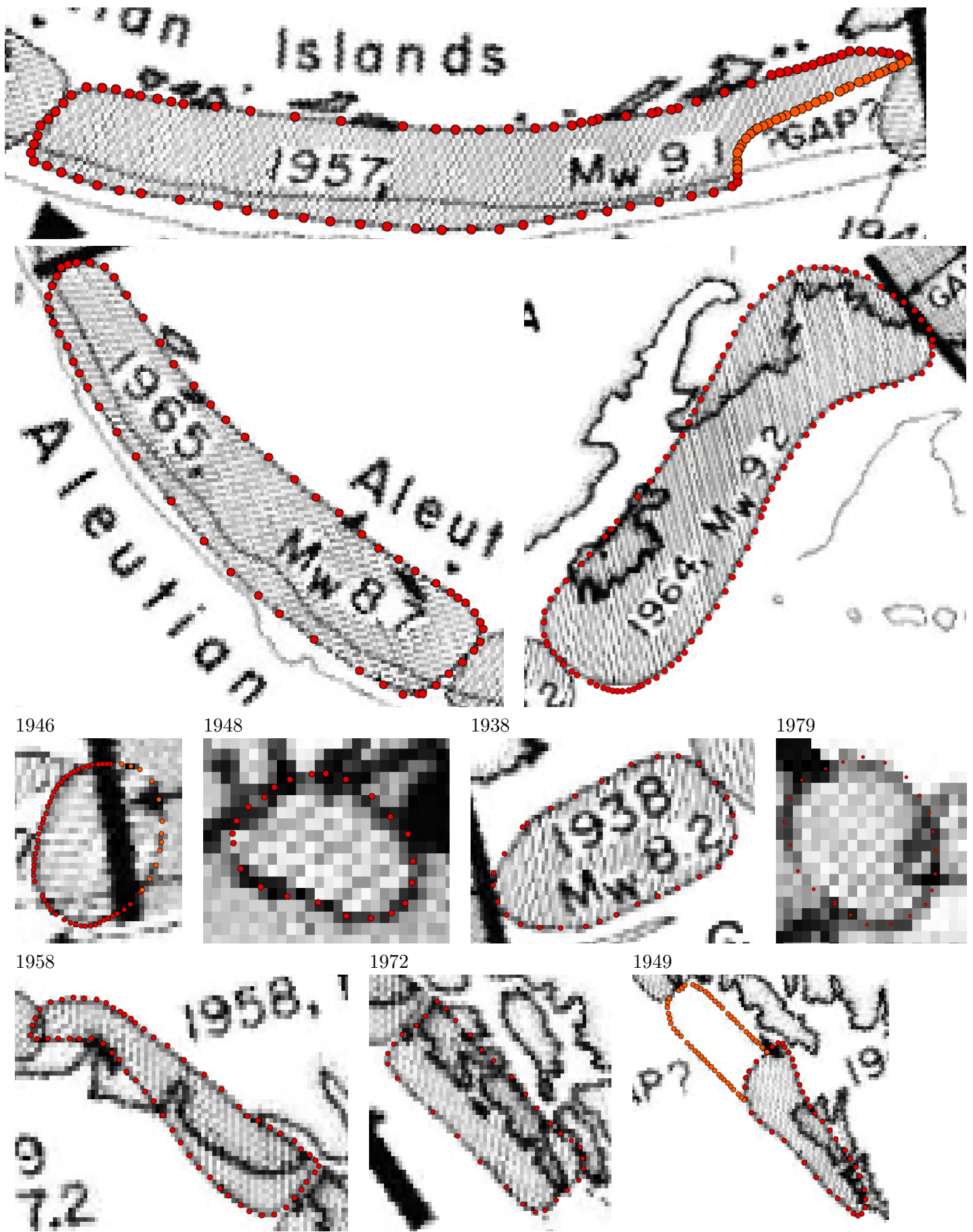
Figure B6: Digitized boundaries for the aftershock regions of *Sykes et al.* (1981). Red dots denote the solid boundaries; orange dots (1957, 1946, 1949) denote the dashed line boundaries.