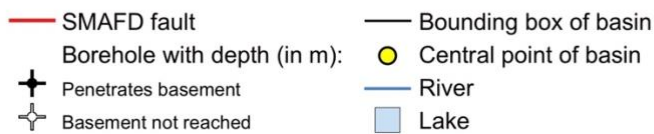
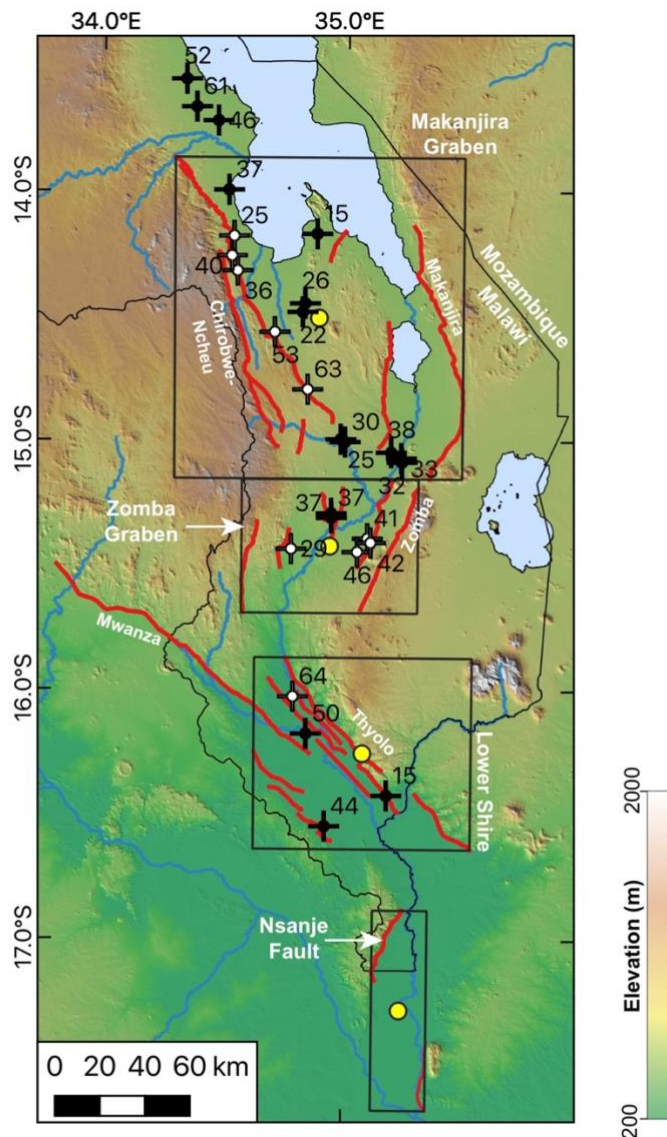


1    **Figure S1**



2

3    Figure S1: Active fault map for southern Malawi with extent and central point of its basins,  
4    from which the Nubia-Rovuma plate motion vectors were derived (Table 3). Labelled faults  
5    indicate border faults in the South Malawi Seismogenic Source Database (SMSSD). Location  
6    of boreholes also shown (Bloomfield and Garson, 1965; Habgood, 1963; Habgood et al.,  
7    1973; Walshaw, 1965; Walter, 1972). Mwanza basin extent not shown, as extension rate of

8 this basin is not constrained by geodesy. Map underlain by 30 m resolution Shuttle Radar

9 Topographic Mission digital elevation model.

10

11

12 **Table S1**

| Combination | Compo                      |             |                       |          |                         |     |          | Natural                 |
|-------------|----------------------------|-------------|-----------------------|----------|-------------------------|-----|----------|-------------------------|
|             | ment of regional extension | $v$ (mm/yr) | $\phi$ ( $^{\circ}$ ) | $\delta$ | C1 ( $\text{m}^{1/3}$ ) | C2  | $L$ (km) | log Recurrence Interval |
| 1           | 0.1                        | 2.53        | 85                    | 65       | 12                      | 12  | 9.6      | 7.37                    |
| 2           | 0.02                       | 2.53        | 85                    | 65       | 12                      | 1.5 | 9.6      | 6.90                    |
| 3           | 0.1                        | 0.2         | 85                    | 65       | 12                      | 1.5 | 9.6      | 7.83                    |
| 4           | 0.02                       | 0.2         | 85                    | 65       | 12                      | 12  | 9.6      | 11.52                   |
| 5           | 0.1                        | 2.53        | 85                    | 65       | 12                      | 1.5 | 38       | 6.44                    |
| 6           | 0.02                       | 2.53        | 85                    | 65       | 12                      | 12  | 38       | 10.13                   |
| 7           | 0.1                        | 0.2         | 85                    | 65       | 12                      | 12  | 38       | 11.06                   |
| 8           | 0.02                       | 0.2         | 85                    | 65       | 12                      | 1.5 | 38       | 10.59                   |
| 9           | 0.1                        | 2.53        | 61                    | 65       | 12                      | 1.5 | 9.6      | 5.62                    |
| 10          | 0.02                       | 2.53        | 61                    | 65       | 12                      | 12  | 9.6      | 9.31                    |
| 11          | 0.1                        | 0.2         | 61                    | 65       | 12                      | 12  | 9.6      | 10.24                   |
| 12          | 0.02                       | 0.2         | 61                    | 65       | 12                      | 1.5 | 9.6      | 9.77                    |
| 13          | 0.1                        | 2.53        | 61                    | 65       | 12                      | 12  | 38       | 8.84                    |
| 14          | 0.02                       | 2.53        | 61                    | 65       | 12                      | 1.5 | 38       | 8.37                    |
| 15          | 0.1                        | 0.2         | 61                    | 65       | 12                      | 1.5 | 38       | 9.30                    |
| 16          | 0.02                       | 0.2         | 61                    | 65       | 12                      | 12  | 38       | 12.99                   |
| 17          | 0.1                        | 2.53        | 85                    | 40       | 12                      | 1.5 | 9.6      | 5.89                    |
| 18          | 0.02                       | 2.53        | 85                    | 40       | 12                      | 12  | 9.6      | 9.58                    |
| 19          | 0.1                        | 0.2         | 85                    | 40       | 12                      | 12  | 9.6      | 10.51                   |
| 20          | 0.02                       | 0.2         | 85                    | 40       | 12                      | 1.5 | 9.6      | 10.04                   |
| 21          | 0.1                        | 2.53        | 85                    | 40       | 12                      | 12  | 38       | 9.12                    |
| 22          | 0.02                       | 2.53        | 85                    | 40       | 12                      | 1.5 | 38       | 8.65                    |
| 23          | 0.1                        | 0.2         | 85                    | 40       | 12                      | 1.5 | 38       | 9.57                    |
| 24          | 0.02                       | 0.2         | 85                    | 40       | 12                      | 12  | 38       | 13.26                   |
| 25          | 0.1                        | 2.53        | 61                    | 40       | 12                      | 12  | 9.6      | 8.29                    |
| 26          | 0.02                       | 2.53        | 61                    | 40       | 12                      | 1.5 | 9.6      | 7.82                    |
| 27          | 0.1                        | 0.2         | 61                    | 40       | 12                      | 1.5 | 9.6      | 8.75                    |
| 28          | 0.02                       | 0.2         | 61                    | 40       | 12                      | 12  | 9.6      | 12.44                   |
| 29          | 0.1                        | 2.53        | 61                    | 40       | 12                      | 1.5 | 38       | 7.36                    |
| 30          | 0.02                       | 2.53        | 61                    | 40       | 12                      | 12  | 38       | 11.05                   |
| 31          | 0.1                        | 0.2         | 61                    | 40       | 12                      | 12  | 38       | 11.98                   |

|             |          |        |            |          |                     |     |          |          |
|-------------|----------|--------|------------|----------|---------------------|-----|----------|----------|
| 32          | 0.02     | 0.2    | 61         | 40       | 12                  | 1.5 | 38       | 11.51    |
| 33          | 0.1      | 2.53   | 85         | 65       | 25                  | 1.5 | 9.6      | 5.66     |
| Combination | Compo    |        |            |          |                     |     |          | Natural  |
|             | nent of  | $v$    |            |          |                     |     |          | log      |
|             | regional | (mm/yr | $\phi$ (°) | $\delta$ | C1                  | C2  | $L$ (km) | Reccurre |
|             | extensio | )      |            |          | (m <sup>1/3</sup> ) |     |          | n        |
|             | n        |        |            |          |                     |     |          | Interval |
| 34          | 0.02     | 2.53   | 85         | 65       | 25                  | 12  | 9.6      | 9.35     |
| 35          | 0.1      | 0.2    | 85         | 65       | 25                  | 12  | 9.6      | 10.28    |
| 36          | 0.02     | 0.2    | 85         | 65       | 25                  | 1.5 | 9.6      | 9.81     |
| 37          | 0.1      | 2.53   | 85         | 65       | 25                  | 12  | 38       | 8.89     |
| 38          | 0.02     | 2.53   | 85         | 65       | 25                  | 1.5 | 38       | 8.42     |
| 39          | 0.1      | 0.2    | 85         | 65       | 25                  | 1.5 | 38       | 9.35     |
| 40          | 0.02     | 0.2    | 85         | 65       | 25                  | 12  | 38       | 13.04    |
| 41          | 0.1      | 2.53   | 61         | 65       | 25                  | 12  | 9.6      | 8.07     |
| 42          | 0.02     | 2.53   | 61         | 65       | 25                  | 1.5 | 9.6      | 7.60     |
| 43          | 0.1      | 0.2    | 61         | 65       | 25                  | 1.5 | 9.6      | 8.52     |
| 44          | 0.02     | 0.2    | 61         | 65       | 25                  | 12  | 9.6      | 12.21    |
| 45          | 0.1      | 2.53   | 61         | 65       | 25                  | 1.5 | 38       | 7.13     |
| 46          | 0.02     | 2.53   | 61         | 65       | 25                  | 12  | 38       | 10.82    |
| 47          | 0.1      | 0.2    | 61         | 65       | 25                  | 12  | 38       | 11.75    |
| 48          | 0.02     | 0.2    | 61         | 65       | 25                  | 1.5 | 38       | 11.28    |
| 49          | 0.1      | 2.53   | 85         | 40       | 25                  | 12  | 9.6      | 8.34     |
| 50          | 0.02     | 2.53   | 85         | 40       | 25                  | 1.5 | 9.6      | 7.87     |
| 51          | 0.1      | 0.2    | 85         | 40       | 25                  | 1.5 | 9.6      | 8.79     |
| 52          | 0.02     | 0.2    | 85         | 40       | 25                  | 12  | 9.6      | 12.48    |
| 53          | 0.1      | 2.53   | 85         | 40       | 25                  | 1.5 | 38       | 7.40     |
| 54          | 0.02     | 2.53   | 85         | 40       | 25                  | 12  | 38       | 11.09    |
| 55          | 0.1      | 0.2    | 85         | 40       | 25                  | 12  | 38       | 12.02    |
| 56          | 0.02     | 0.2    | 85         | 40       | 25                  | 1.5 | 38       | 11.55    |
| 57          | 0.1      | 2.53   | 61         | 40       | 25                  | 1.5 | 9.6      | 6.58     |
| 58          | 0.02     | 2.53   | 61         | 40       | 25                  | 12  | 9.6      | 10.27    |
| 59          | 0.1      | 0.2    | 61         | 40       | 25                  | 12  | 9.6      | 11.20    |
| 60          | 0.02     | 0.2    | 61         | 40       | 25                  | 1.5 | 9.6      | 10.73    |
| 61          | 0.1      | 2.53   | 61         | 40       | 25                  | 12  | 38       | 9.81     |
| 62          | 0.02     | 2.53   | 61         | 40       | 25                  | 1.5 | 38       | 9.34     |
| 63          | 0.1      | 0.2    | 61         | 40       | 25                  | 1.5 | 38       | 10.26    |
| 64          | 0.02     | 0.2    | 61         | 40       | 25                  | 12  | 38       | 13.95    |

Table S1: Input parameter combinations and Chingale Step fault central section recurrence intervals using upper and lower values outlined in Table 5, and a fractional factorial approach with  $2^{k-p}$  combinations where  $k$  is 7 and  $p$  is 1. This table is derived where values for  $\nu$  are taken from the Saria et al. (2013) geodetic model. For sensitivity analysis using the Stamps et al. (2008) geodetic model, the upper and lower values for  $\nu$  are 2.56 and 3.12 mm/yr respectively (Table 5). The design of this table (i.e. whether an upper or lower value of each parameter is chosen) is derived from Box et al. (1978) and can be accessed at: <https://www.itl.nist.gov/div898/handbook/pri/section3/eqns/2to7m1.txt> (date last accessed 30/03/2020).

23    **Table S2**

| <b>Compon</b>              |                  |                         |                          |                            |           |           |          |
|----------------------------|------------------|-------------------------|--------------------------|----------------------------|-----------|-----------|----------|
| <b>Paramet</b>             | <b>ent of</b>    | <b><math>\nu</math></b> | <b><math>\phi</math></b> | <b><math>\delta</math></b> | <b>C1</b> | <b>C2</b> | <b>L</b> |
| <b>er</b>                  | <b>regional</b>  | <b>(mm/yr)</b>          |                          |                            |           |           |          |
|                            | <b>extension</b> |                         |                          |                            |           |           |          |
| <b>Compon</b>              |                  |                         |                          |                            |           |           |          |
| <b>ent of</b>              |                  |                         |                          |                            |           |           |          |
| <b>regional</b>            |                  |                         |                          |                            |           |           |          |
| <b>extension</b>           |                  |                         |                          |                            |           |           |          |
| <b><math>\nu</math></b>    | 0.00             | -                       |                          |                            |           |           |          |
| <b>(mm/yr)</b>             |                  |                         |                          |                            |           |           |          |
| <b><math>\phi</math></b>   | 0.00             | 0.00                    | -                        |                            |           |           |          |
| <b><math>\delta</math></b> | 0.00             | 0.00                    | 0.00                     | -                          |           |           |          |
| <b>C1</b>                  | 0.00             | 0.00                    | 0.00                     | 0.00                       | -         |           |          |
| <b>C2</b>                  | 0.00             | 0.00                    | 0.00                     | 0.00                       | 0.00      | -         |          |
| <b>L</b>                   | 0.00             | 0.00                    | 0.00                     | 0.00                       | 0.00      | 0.00      | -        |

24    Table S2: Results of parameter-parameter interaction effects on sensitivity analysis using  
25    approach outlined in Eq. A3. All results are zero (to two decimal places), and so there are no  
26    parameter-parameter effects in the sensitivity analysis outlined here. See Appendix A for  
27    discussion.

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