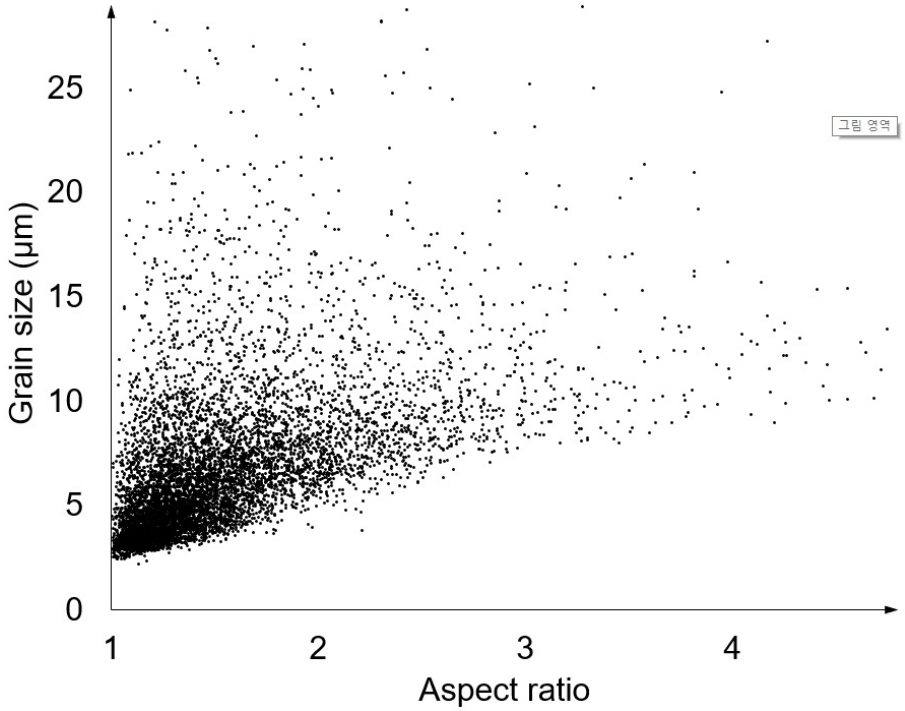


**Figure S1.** The distribution of grain size and aspect ratio of investigated grains.

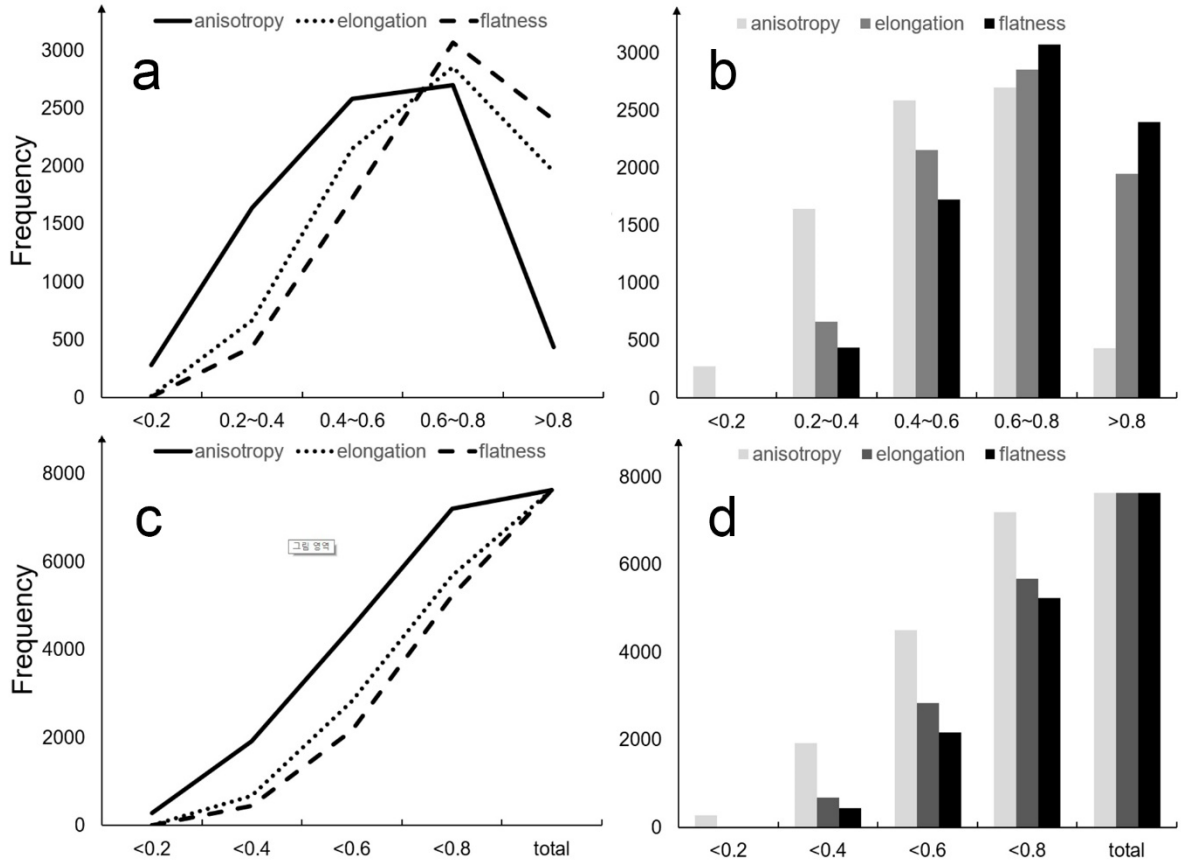


**Figure S2.** Anisotropy (1-a/c), elongation (b/c), and flatness (a/b) distributions of the investigated grains. (**a**) Line graph showing the frequency of each component (**b**) Bar graph (**c**) Cumulative line graph (**d**) Cumulative bar graph.

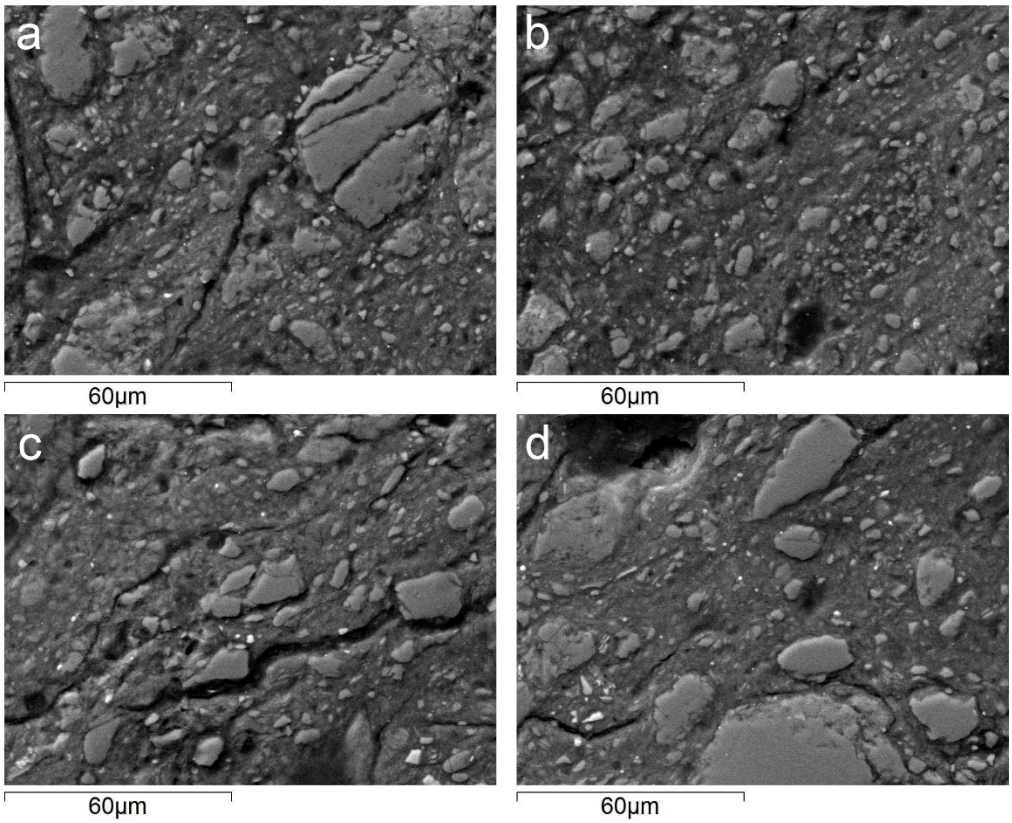


**Figure S3.** Scanning Electron Microscope Back-Scattered Electron (SEM-BSE) image of BK-1 sample.

**Table S1.** SDI examples with γ-values ranging from 10 to 50 for the 3D-SPO results of the fault gouge were presented as the total data, the grain size, volume, and aspect ratio.

| | | N | SPO ($T_o$-$P_o$) | $SDI_{10}$ | $SDI_{20}$ | $SDI_{30}$ | $SDI_{40}$ | $SDI_{50}$ |
|---|---|---|---|---|---|---|---|---|
| **Total Data** | | 7636 | 028-24 | 10.6 | 17.0 | 24.3 | 32.4 | 40.8 |
| Grain size (μm) | <5 | 2834 | 028-22 | 11.7 | 19.1 | 26.4 | 34.8 | 42.8 |
| | 5~10 | 3652 | 029-22 | 12.3 | 20.1 | 27.9 | 36.3 | 44.6 |
| | 10~15 | 823 | 023-20 | 12.8 | 20.7 | 29.1 | 37.0 | 44.9 |
| | >15 | 327 | 025-22 | 12.0 | 19.6 | 27.1 | 34.9 | 43.3 |
| Grain Volume ($\mu m^3$) | <100 | 929 | 030-24 | 13.3 | 21.0 | 29.4 | 37.3 | 45.2 |
| | 100~1000 | 5860 | 025-23 | 11.0 | 17.7 | 24.9 | 33.4 | 41.8 |
| | 1000~10000 | 778 | 026-23 | 12.7 | 20.6 | 28.5 | 36.3 | 43.8 |
| | >10000 | 65 | 022-20 | 8.8 | 16.1 | 25.4 | 32.6 | 40.6 |
| Aspect ratio (c/a) | <1.5 | 1225 | 018-14 | 12.5 | 20.2 | 28.0 | 36.7 | 44.8 |
| | 1.5~2 | 1972 | 029-25 | 12.2 | 19.7 | 27.2 | 35.2 | 43.5 |
| | 2~3 | 2199 | 026-26 | 12.0 | 19.6 | 26.8 | 34.9 | 43.3 |
| | >3 | 2240 | 030-29 | 12.0 | 19.6 | 26.9 | 35.0 | 43.4 |

N: The total number of grains examined. SPO ($T_o$-$P_o$): Trend and Plunge of the direction of most dense points.