Supplementary information 1

Often diatom species delimitation is based on nanoscale ultrastructure that can only be seen with scanning electron microscopy (SEM) (Mann 1999; Round et al. 1990). Because of the lack of light microscopic evidence of multiple species, we explored several fossil samples of *C. andinus* with SEM from the Lake Titicaca drill core record. We air-dried treated sediment samples on to SEM stubs, which we then coated in chromium and imaged on a Hitachi S4 700 Field-Emission SEM at 5kv and 10kv at UNL's Morrison Microscopy Core Research Facility. We found little departure from the species description of *C. andinus* (Tapia et al. 2004). Orientation of the internal labia of the rimoportulae was varied, but it was always located on a costae with an exit pore on the mantle (Supplement 1 Figure A-E). In some samples, rimoportulae did not co-occur with fultoportulae on the same costae (as is does in the *C. andinus* description), and this was more common on smaller older valves (Supplement 1 Figure F). However, Wood and others (1987) found that, in other centric diatoms, the number and arrangement of processes could be a plastic trait that is influenced by ontogeny and environmental factors. Fultoportulae consistently had two satellite pores (Supplement 1 Figure A-B, D). Valves may be slightly undulate or domed, and occasionally spines are well preserved (Supplement 1 Figure E, G-H). An annulus is occasionally present in fossil specimens, but it is also evident in modern *C. andinus* specimens (Supplement 1 Figure H).

Supplementary information 2

Histograms from each of the 266 samples of *C. andinus* from the Lake Titicaca drill core record that we measured for mean valve size (Supplement 2 Figure).

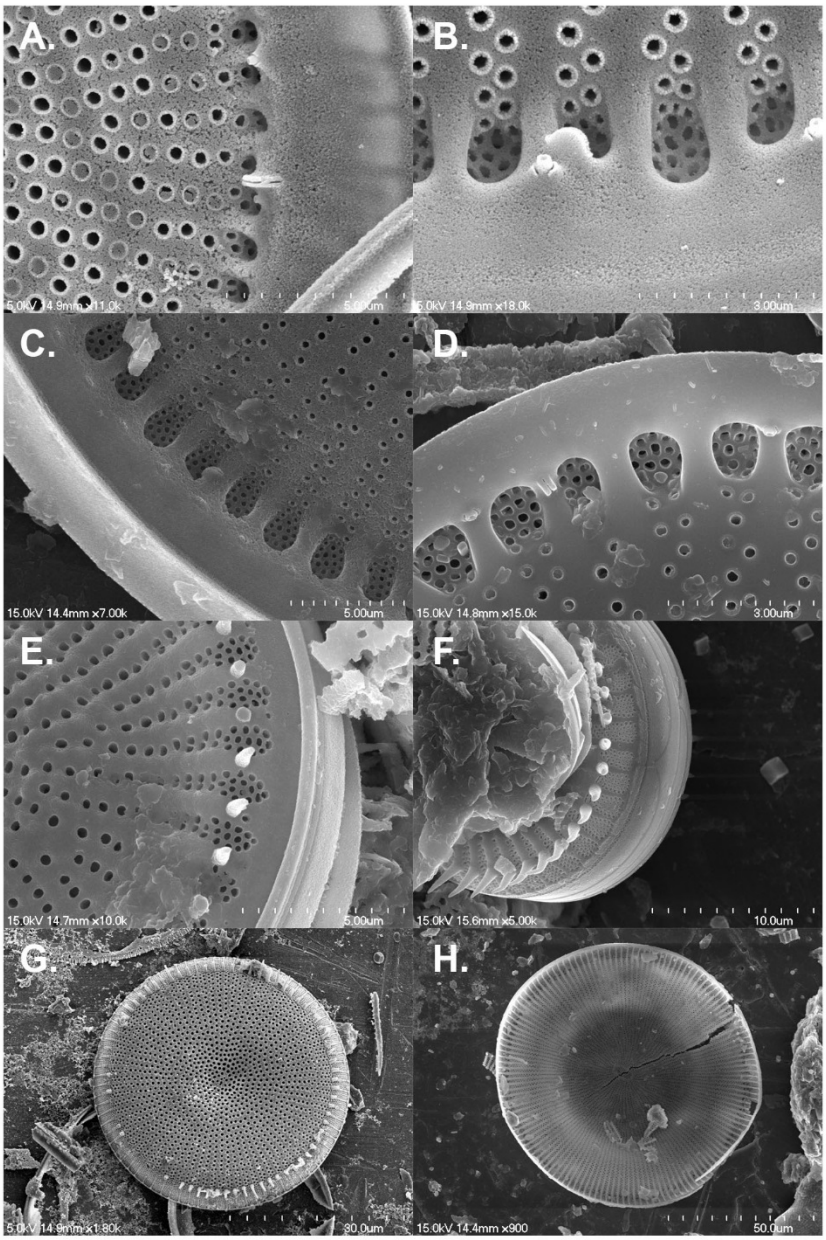
Supplementary References

Mann, D. G. 1999. The species concept in diatoms. Phycologia 38:437– 495.

Round, F. E., R. M. Crawford, and D. G. Mann. 1990. The Diatoms. Cambridge University

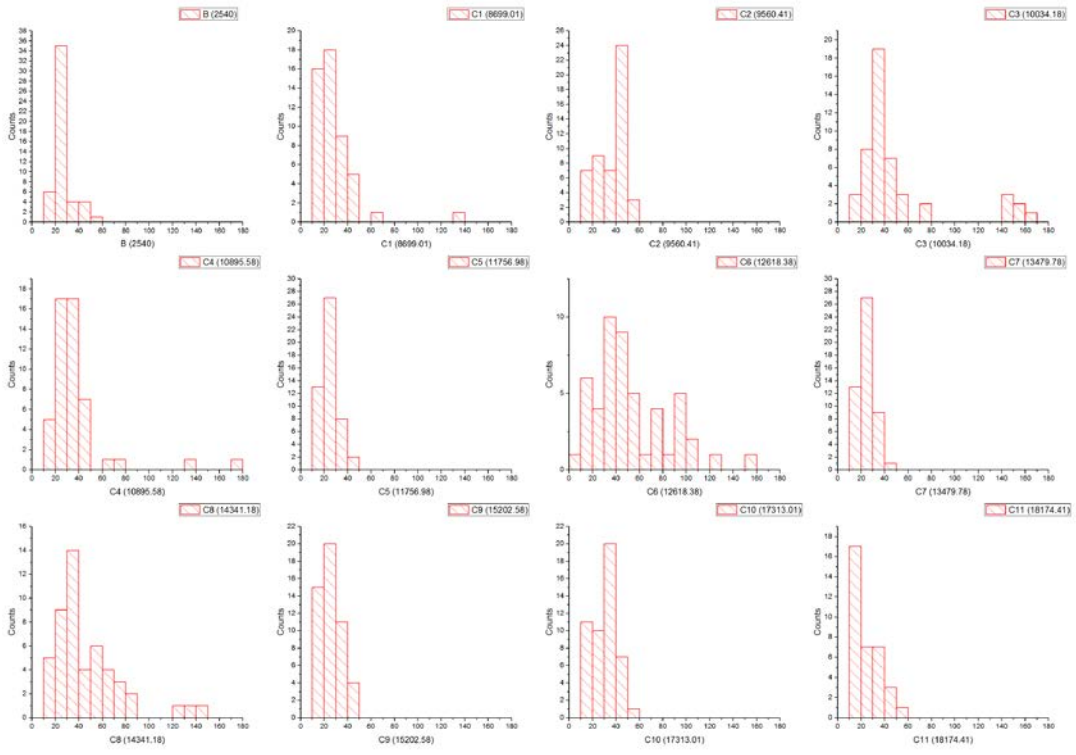
Press, Cambridge.

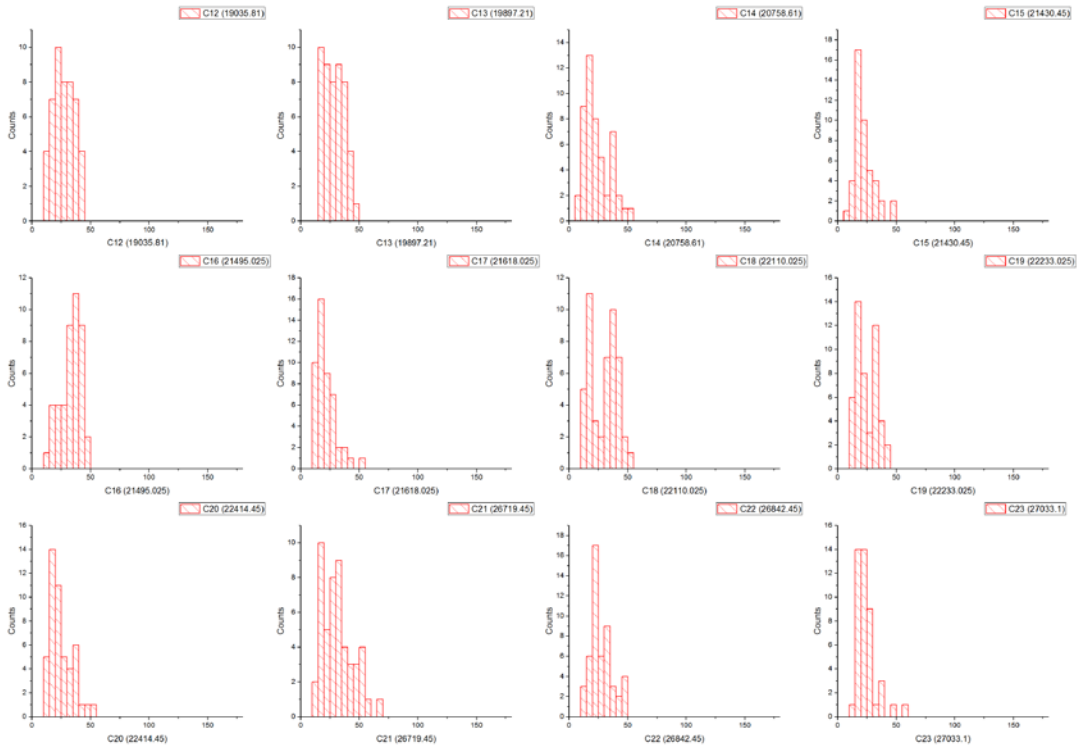
Wood, M., R. Lande, and G. A. Fryxell. 1987. Quantitative genetic analysis of morphological variation in an Antarctic diatom grown at two light intensities. Journal of Phycology 23:42–54.



Supplement 1 Figure *Cyclostephanos andinus*, Lake Titicaca, SEM. Scale bar = 5 µm (A, C, E), 3 µm (B, D), 10 µm (F), 30 µm (G), or 50 µm (H). A-B, G (~47 Ka); C, H (197 Ka); D-E (207 Ka); F (303 Ka). **A.** Horizontal arrangement of the rimoportula, located to the left of the fultoportula. **B.** Diagonal positioning of the rimoportula, located to the left of the fultoportula. **C.** Diagonal positioning of the rimoportula located below the fultoportula. **D.** Fultoportula and rimoportula located on different costae. **E.** External opening of the rimoportula. **F.** External opening of the rimoportula and detail of the girdle bands. **G.** Domed valve face with an abundance of spines. **H.** Undulate valve face without spines, but with an annulus.

Supplement 2 Figure Histograms from each of the 266 samples of *C. andinus* from the Lake Titicaca drill core record that we measured for mean valve size.

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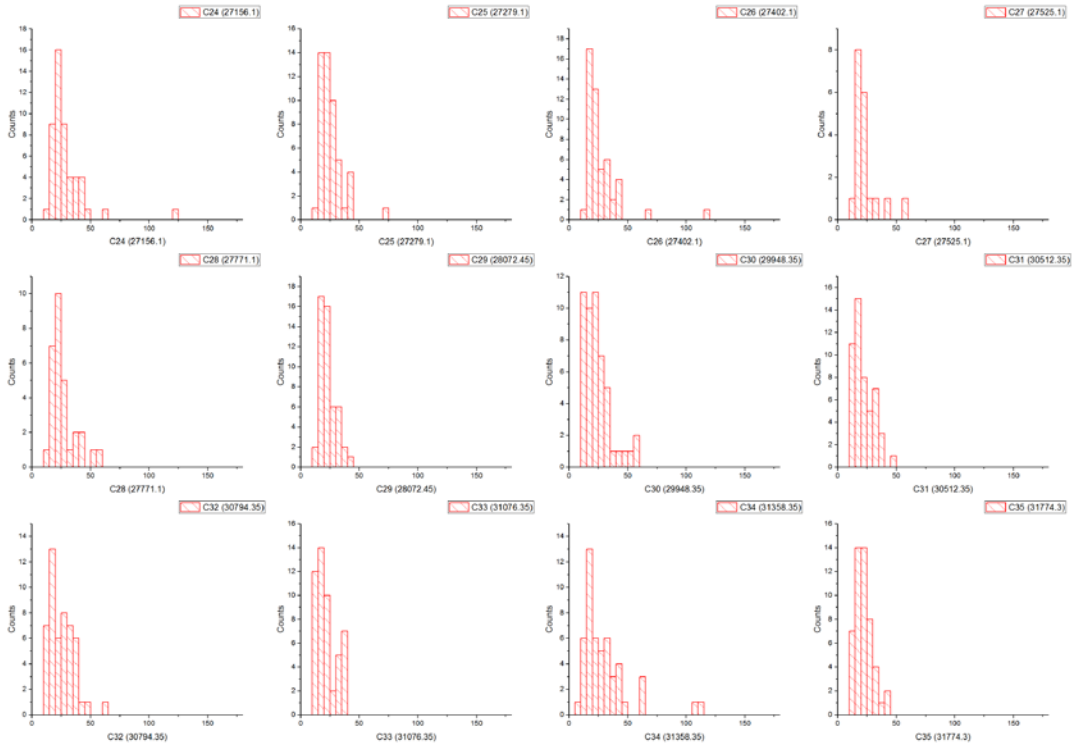
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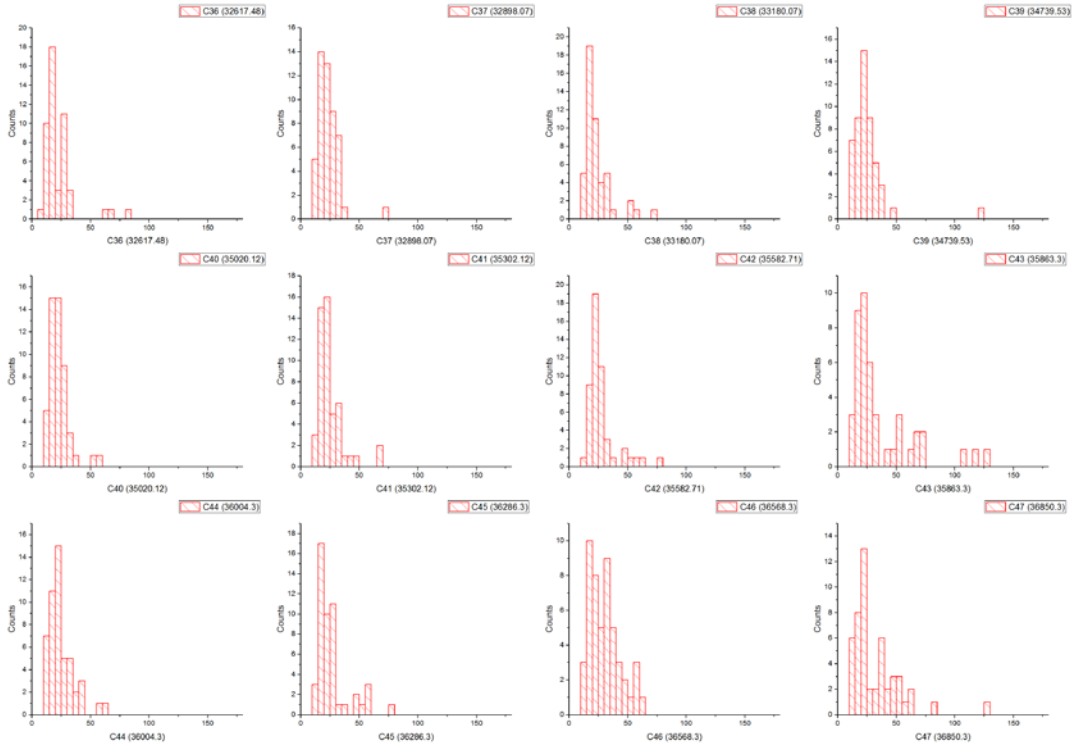
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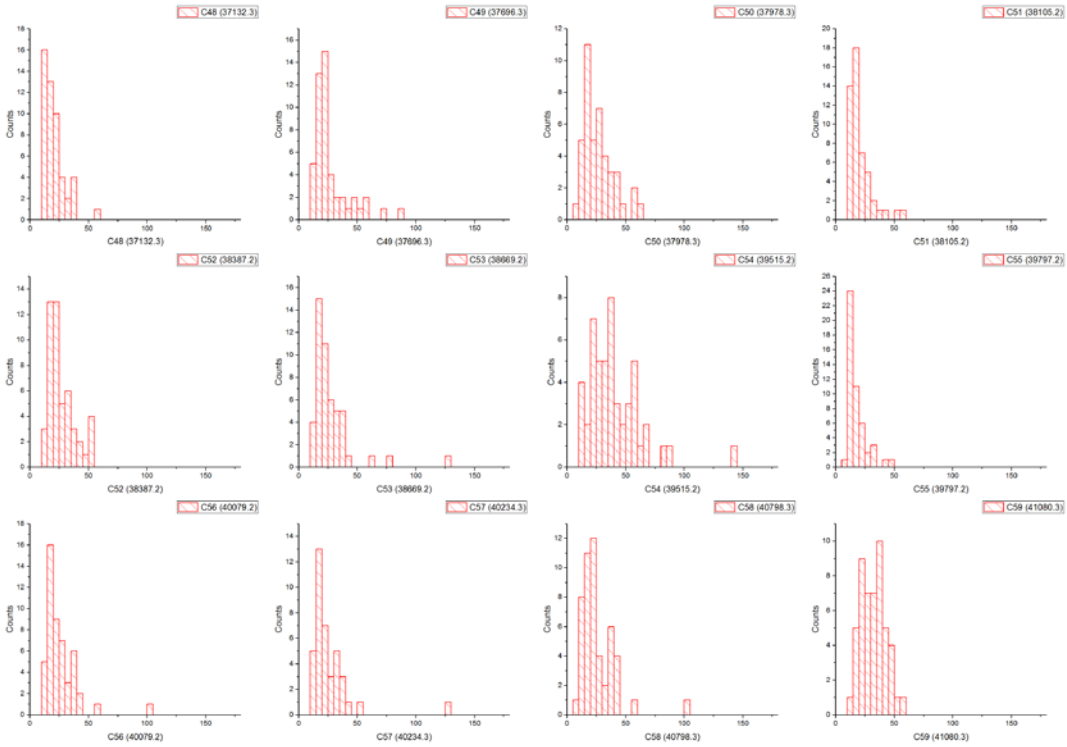
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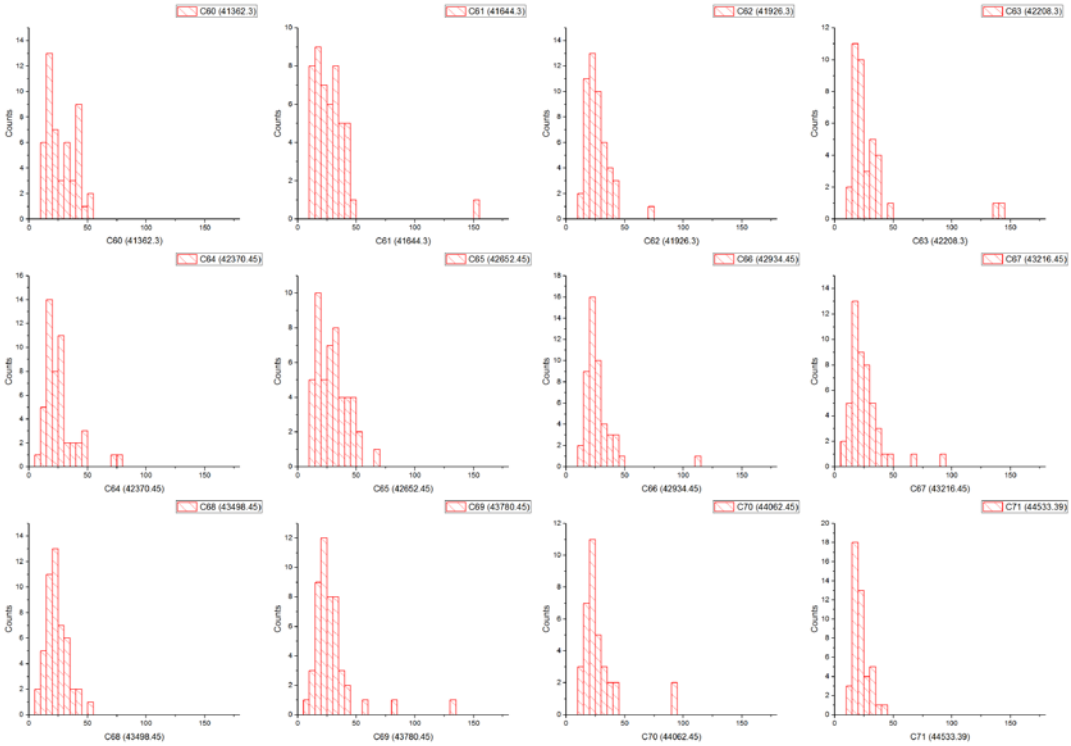
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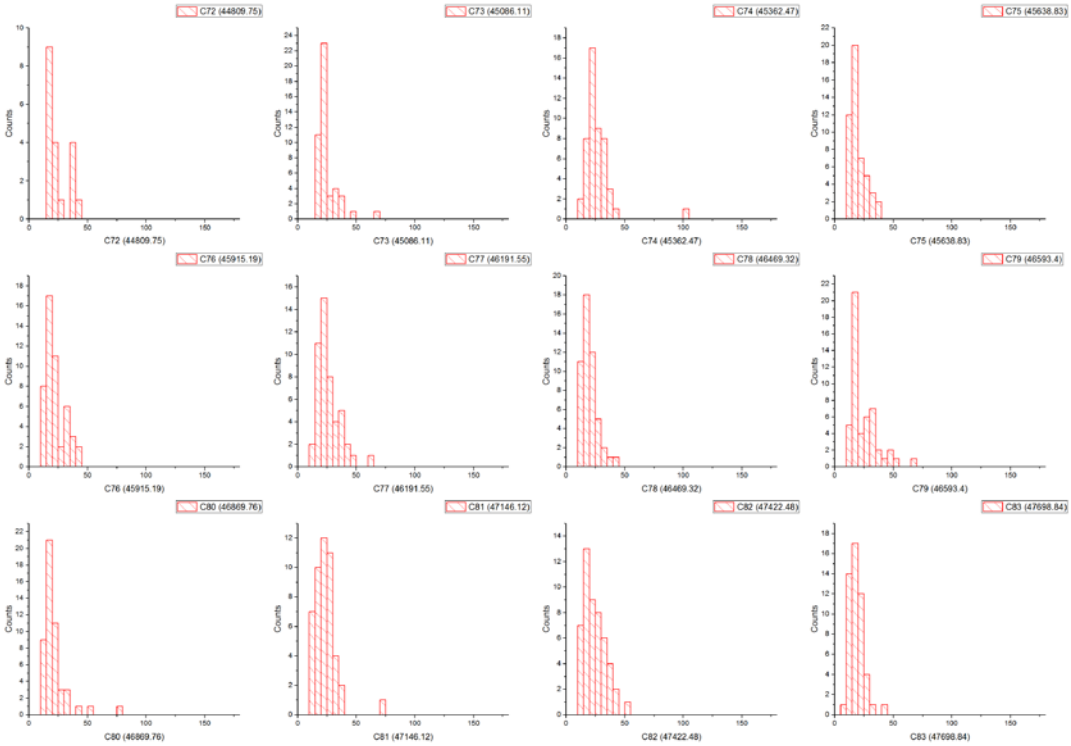
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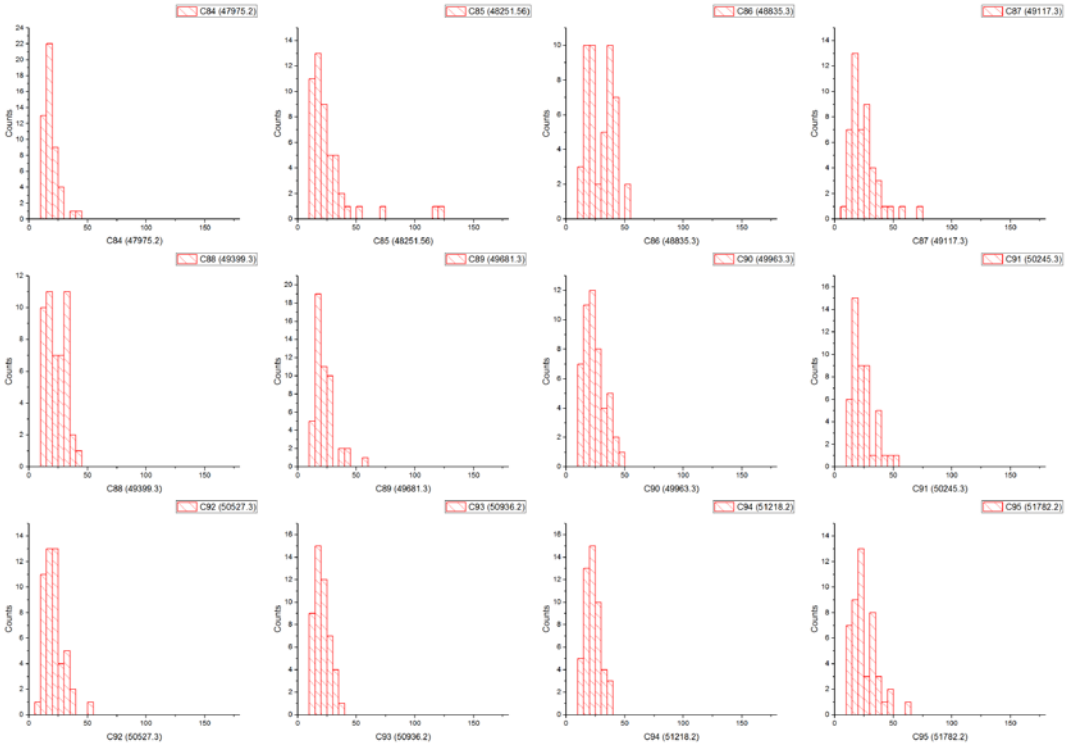
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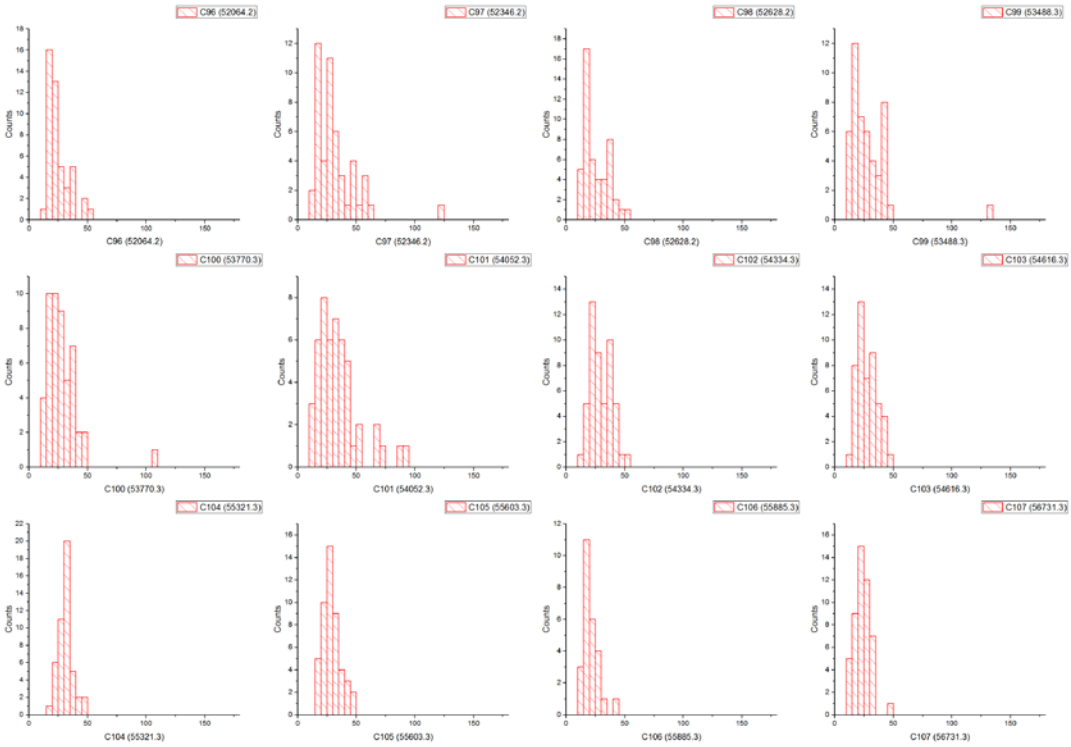
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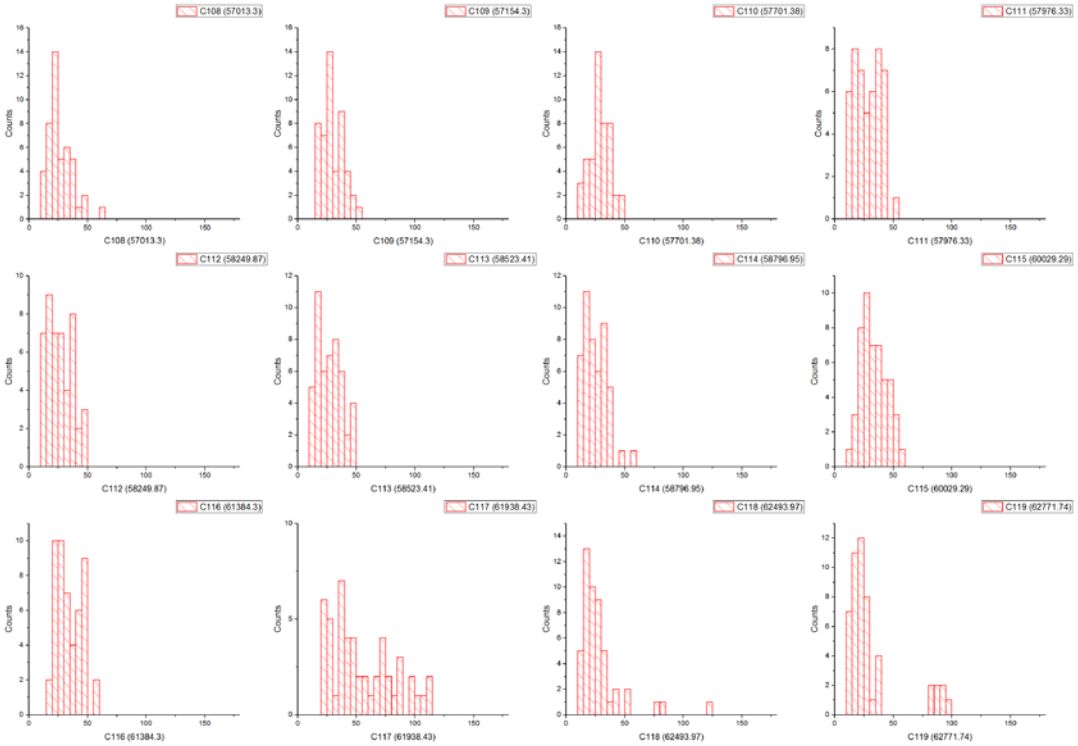
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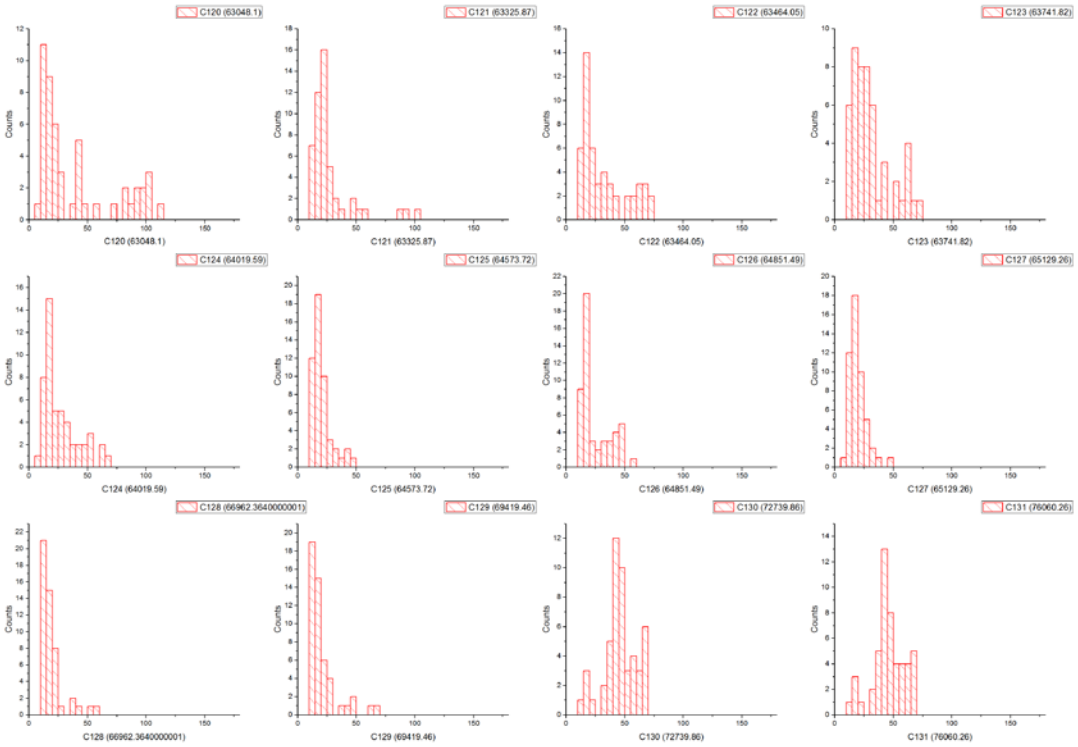
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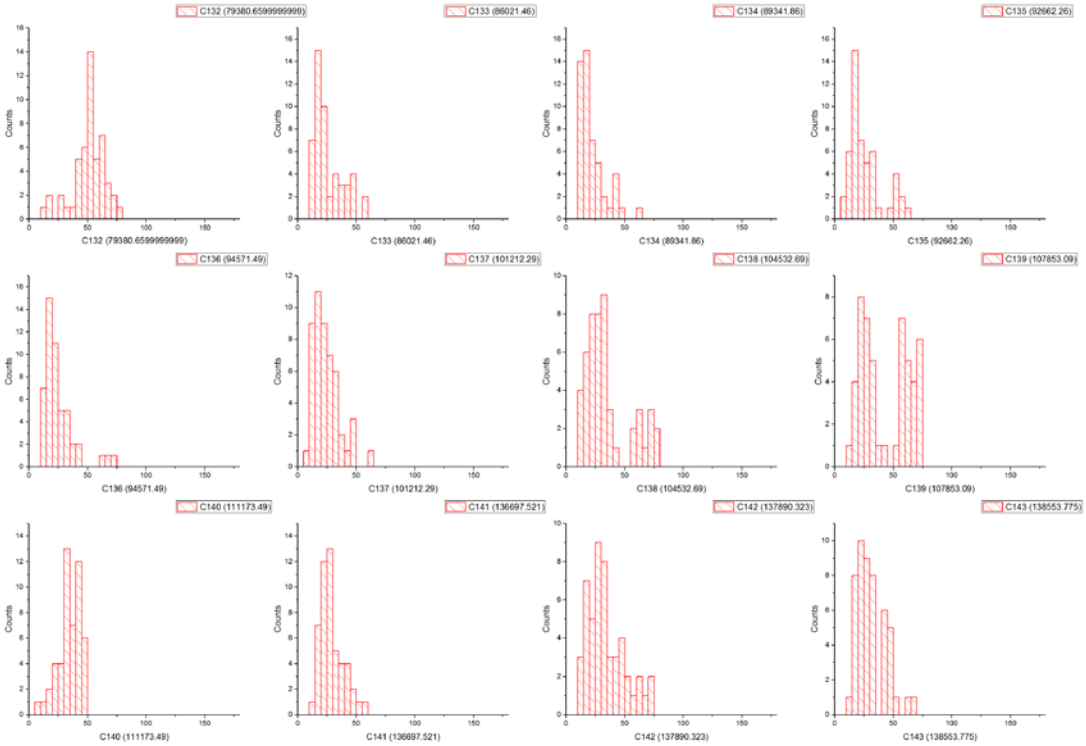
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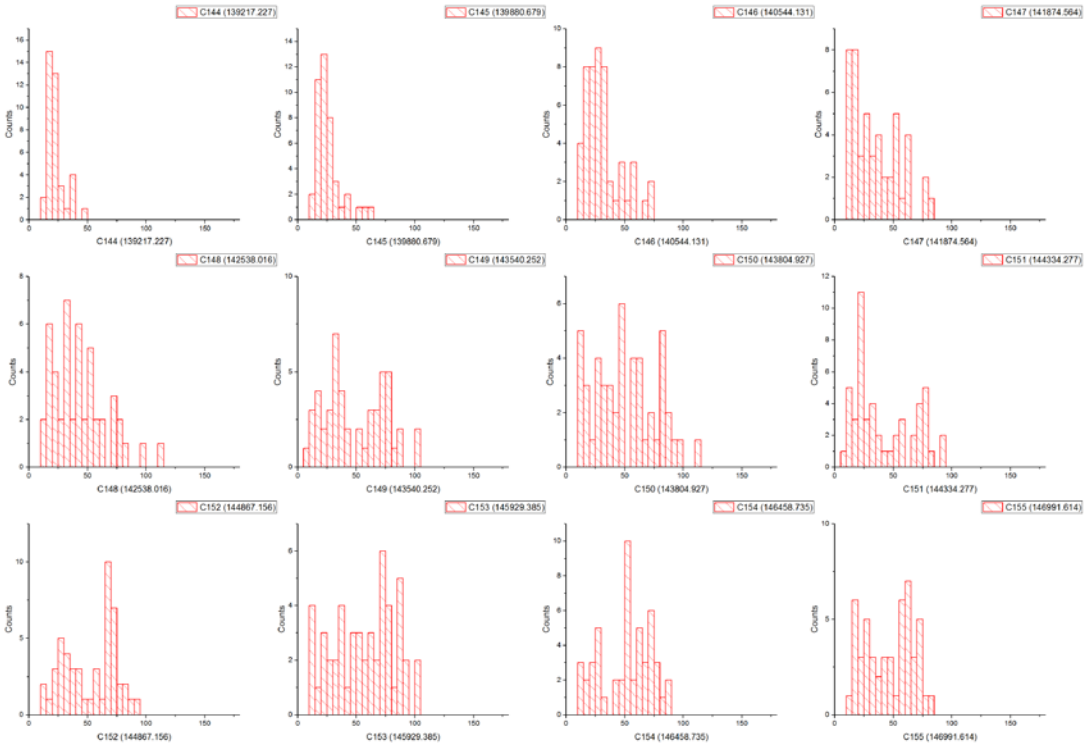
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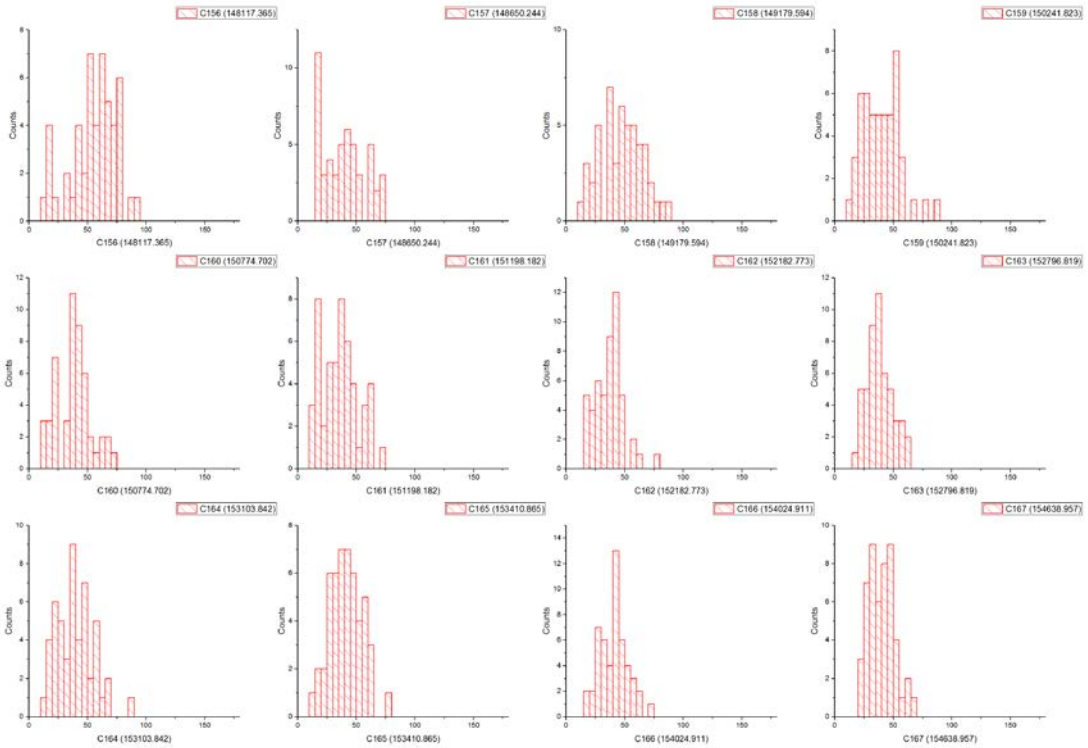
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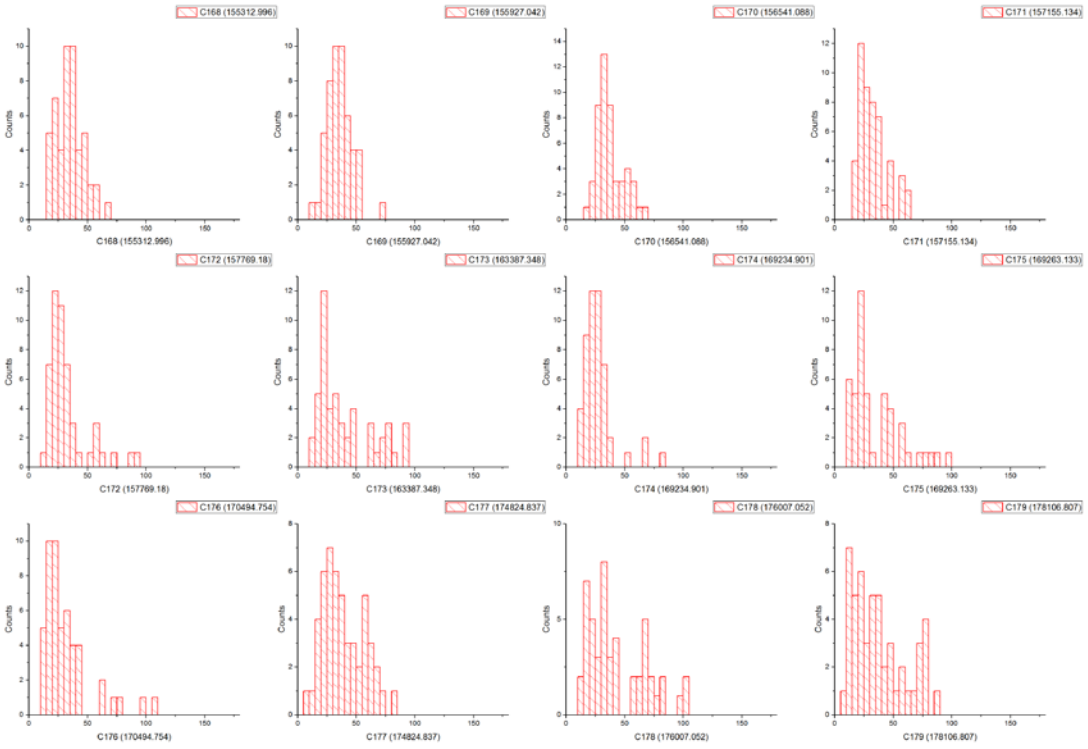
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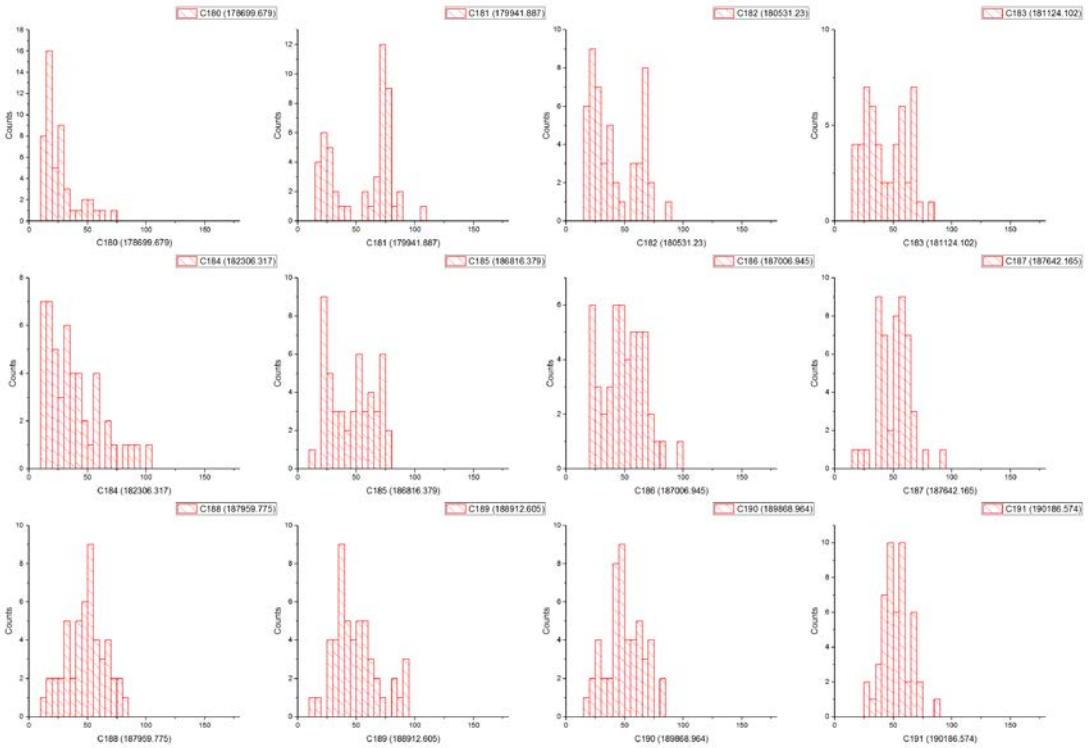
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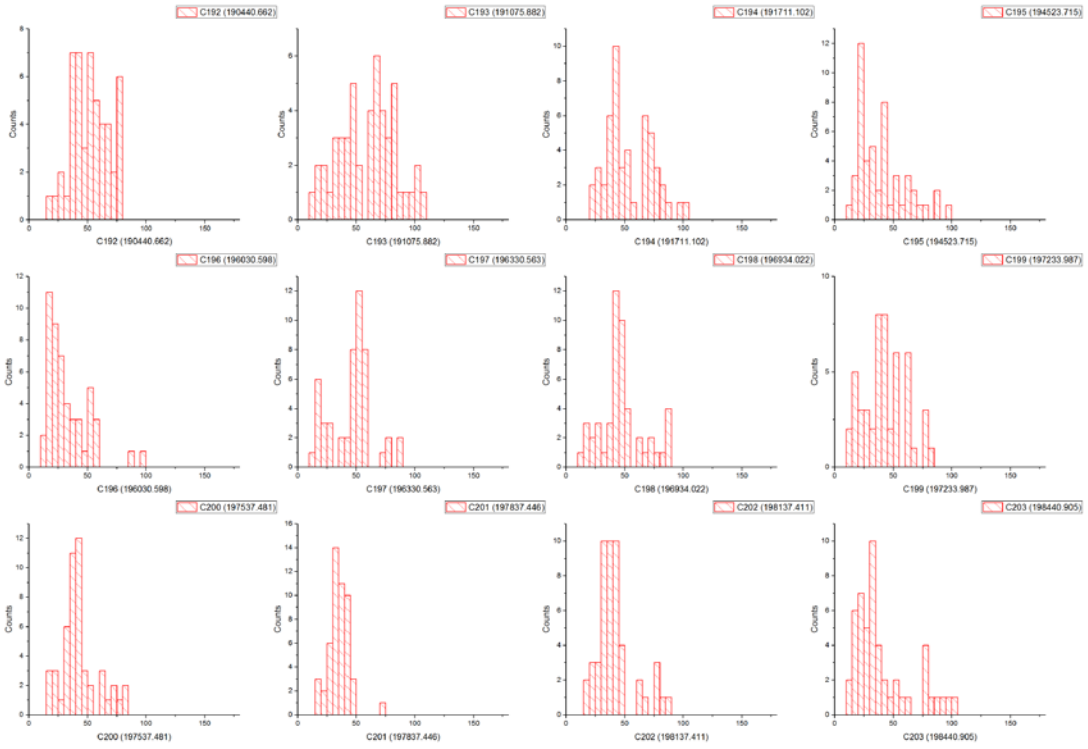
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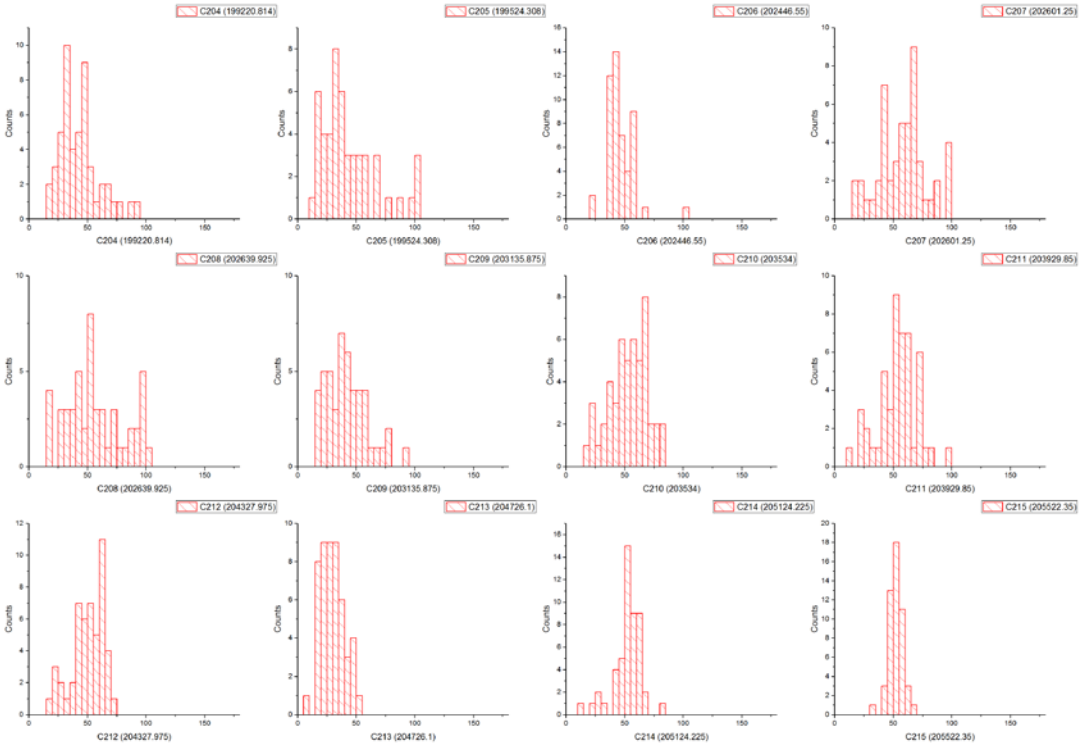
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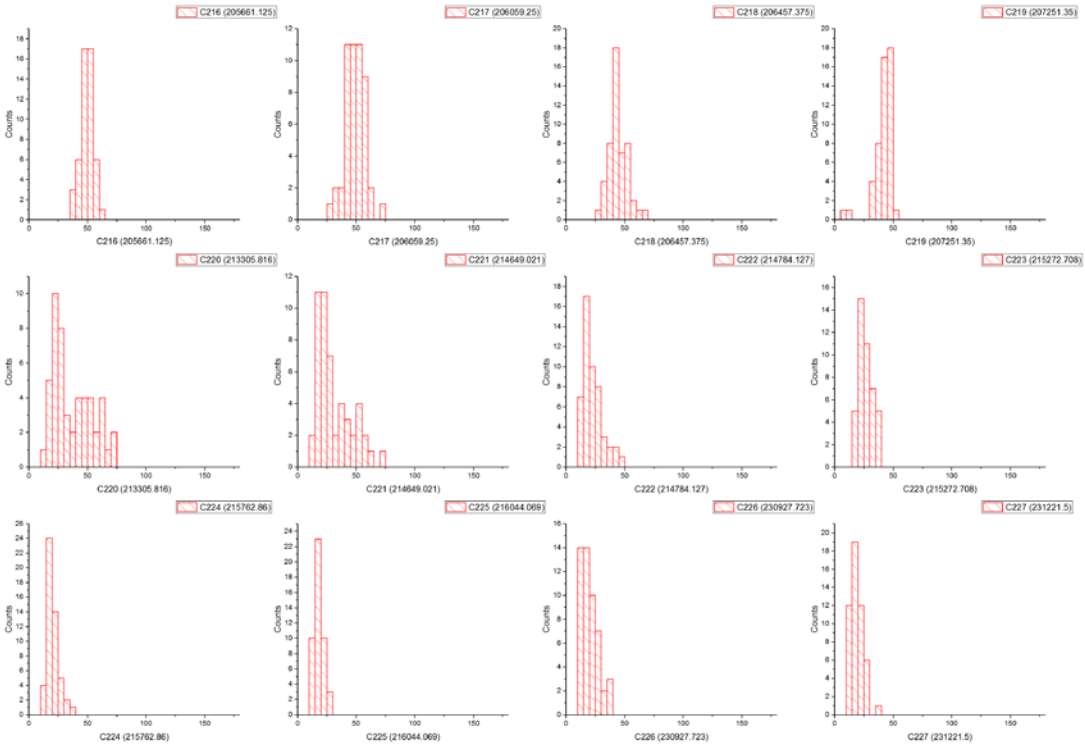
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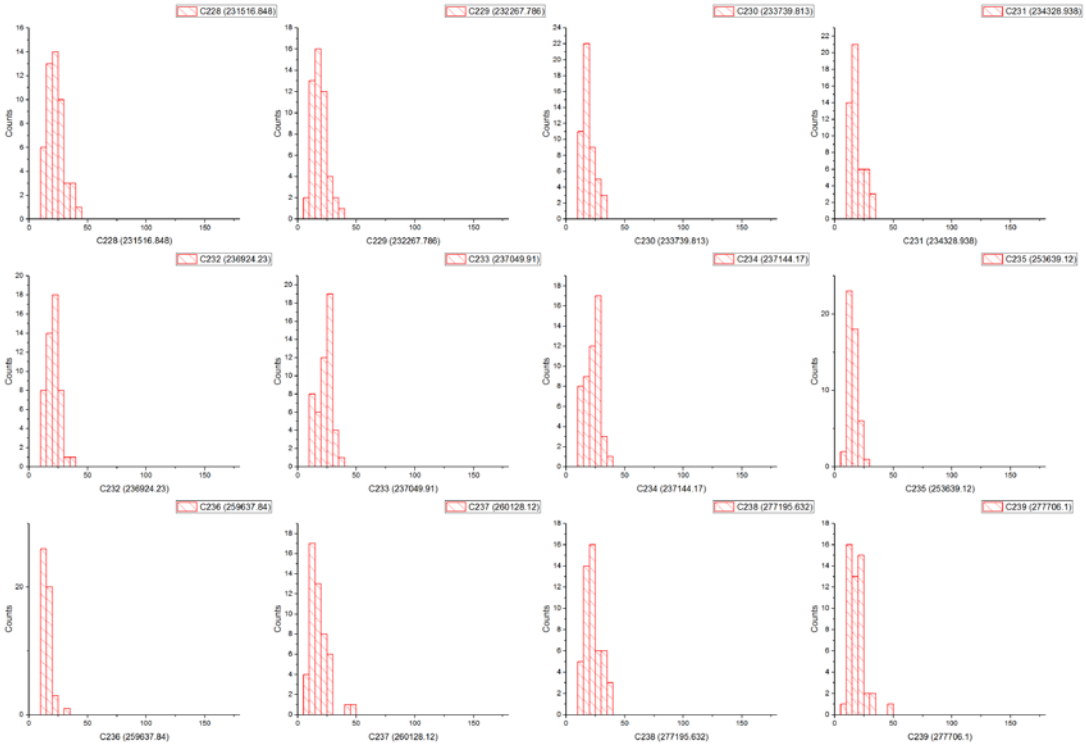
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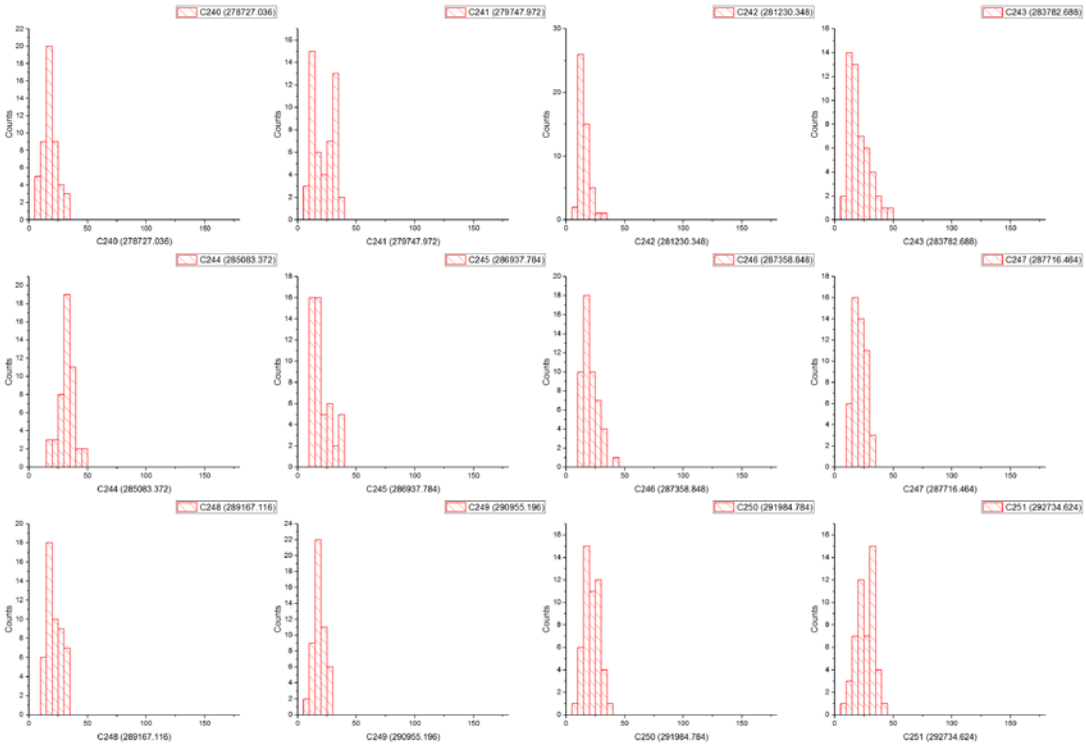
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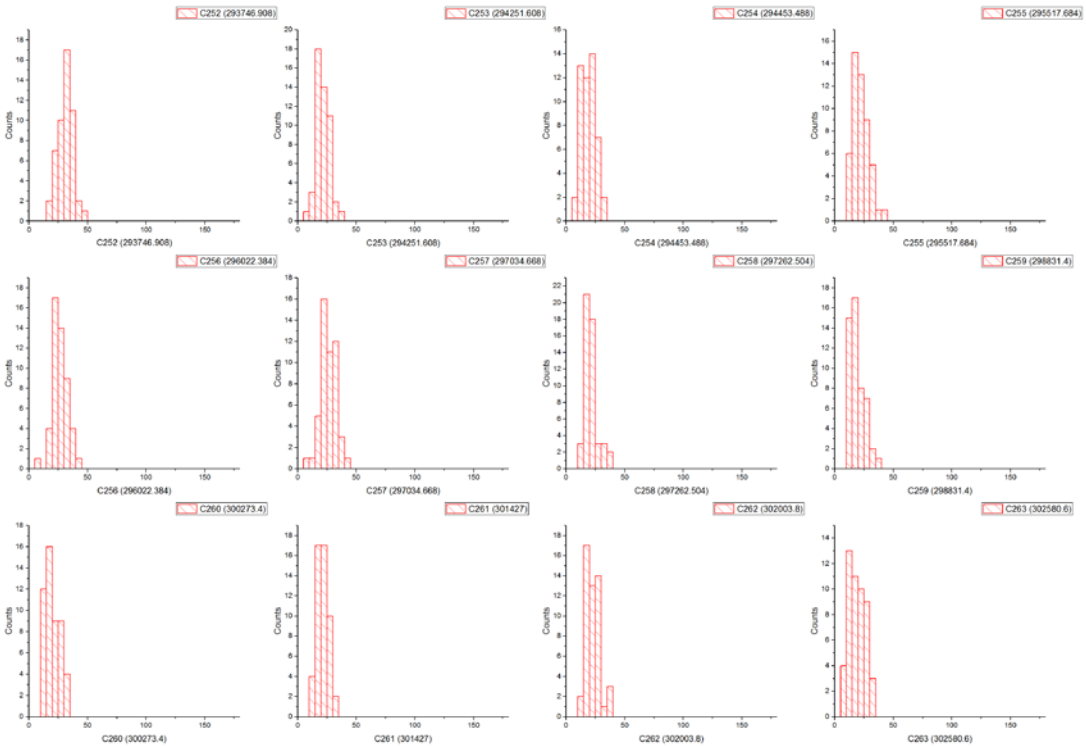
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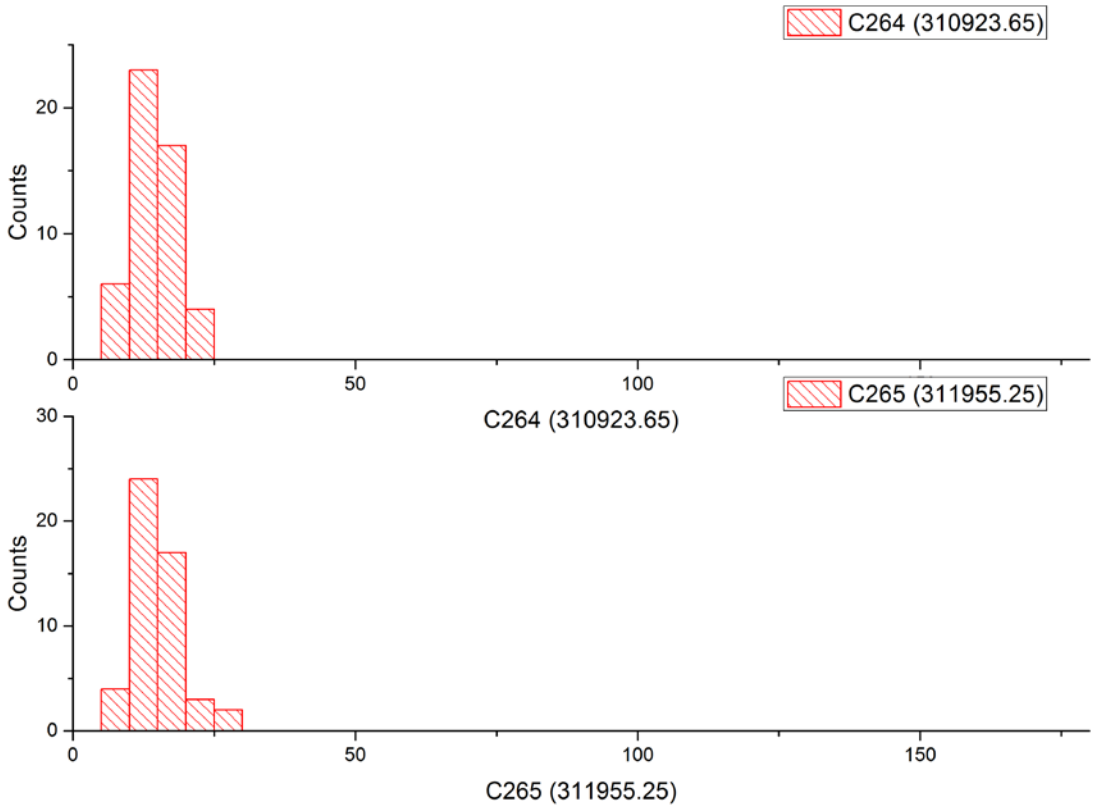
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