Blowick, A., Pe-Piper, G., Piper, D.J.W., Zhang, Y., and Tyrrell, S., 2020, First-cycle sand supply and the evolution of the eastern Canadian continental margin: Insights from Pb isotopes in the Mesozoic Scotian Basin: GSA Bulletin, https://doi.org/10.1130/B35419.1.

Supplemental Material

Supplementary File S1: Statistical Analysis

Table S2: Pb-isotopic compositions of K-feldspar

Supplementary File S3: Thorogenic Pb Plots

Supplementary File S1

APPROACH AND METHODOLOGY: Statistical Analysis

The nature of the statistical analysis builds upon initial tests carried out by Blowick (2017) (PhD thesis) to which readers are referred to.

In order to test the number of grains required for analysis, in line with the realistic capabilities of analytical sessions, we ran a series of background tests using both synthetic data and real case studies. For one test, we created a synthetic dataset in which up to 10 distinct Pb groups were created. In the second test, we used nine samples from the Mississippi system (Blowick et al., 2019), (each with 4 Pb groups) in which a minimum of 100 and a maximum of 150 K-feldspar grains had been analysed. Results in both cases were compared with samples from the Wessex Basin from Lancaster et al. (2017).

Using MATLAB coding, successive sub-groups of 10, 20, 30, all the way up to 150 grains were randomly selected from 100 up to 5000 times in each sample and the abundance of each Pb group was counted within each sampling event. Comparison of detection rates using between 100-5000 random selection events, and repetition of the selection events ten times, enables any statistical bias associated with the total number of selections to be assessed.

Unlike detrital geochronology studies which may consider successfully detected groups as those which exceed a certain threshold value in order to be distinguished from background spectra, e.g. n = 3 grains (cf. Andersen, 2005), the large natural variability observed within Pb isotopic groups (e.g. Pb group 3 in the Mississippi River – cf. Figure 4, Blowick et al., 2019 and Figure S1.2 below) mean an arbitrary threshold value is impractical. As such, we considered two cases – one in which an individual Pb group is considered detected once a single grain belonging to that has been counted, and another in which a minimum of 3 grains is required to recognise a distinct Pb group. Within each test we also consider two parameters: (1) how many grains are required for all possible Pb groups to be detected and (2) how many grains are required to provide a representative abundance of each group.

With respect to the first parameter (detection) both the synthetic and real datasets produce similar results; a minimum of 40 grains are required to be analysed in order to detect a Pb group which represents ≥6% of the total analysed sample with ≥95% confidence (i.e. a group which represented ≥6% of the total analysed sample was detected in more than 94.88% or 4744 of 5000 selection events in Mississippi samples, and greater than 94.58% or 4729 of 5000 selection events in the synthetic dataset). If we consider three grains as the threshold for a Pb group to be identified with >94.5% confidence, then this increases the necessary grain numbers to 80 in both datasets. However, due to the large possible spread in Pb isotopic compositions within a single source, we must consider every grain as an important source identifier.

With respect to the second parameter (abundance), systematically plotting all the relative abundances of each Pb group in analytical order reveals little variation in the abundances of each Pb group after analysis of more than forty grains (Figure S1.2 below). Exceeding forty grains replicates the same number of Pb groups and similar abundances (to within 20% with the bulk of samples showing <10% difference). As a result, we analyse a minimum of 40 grains per sample.

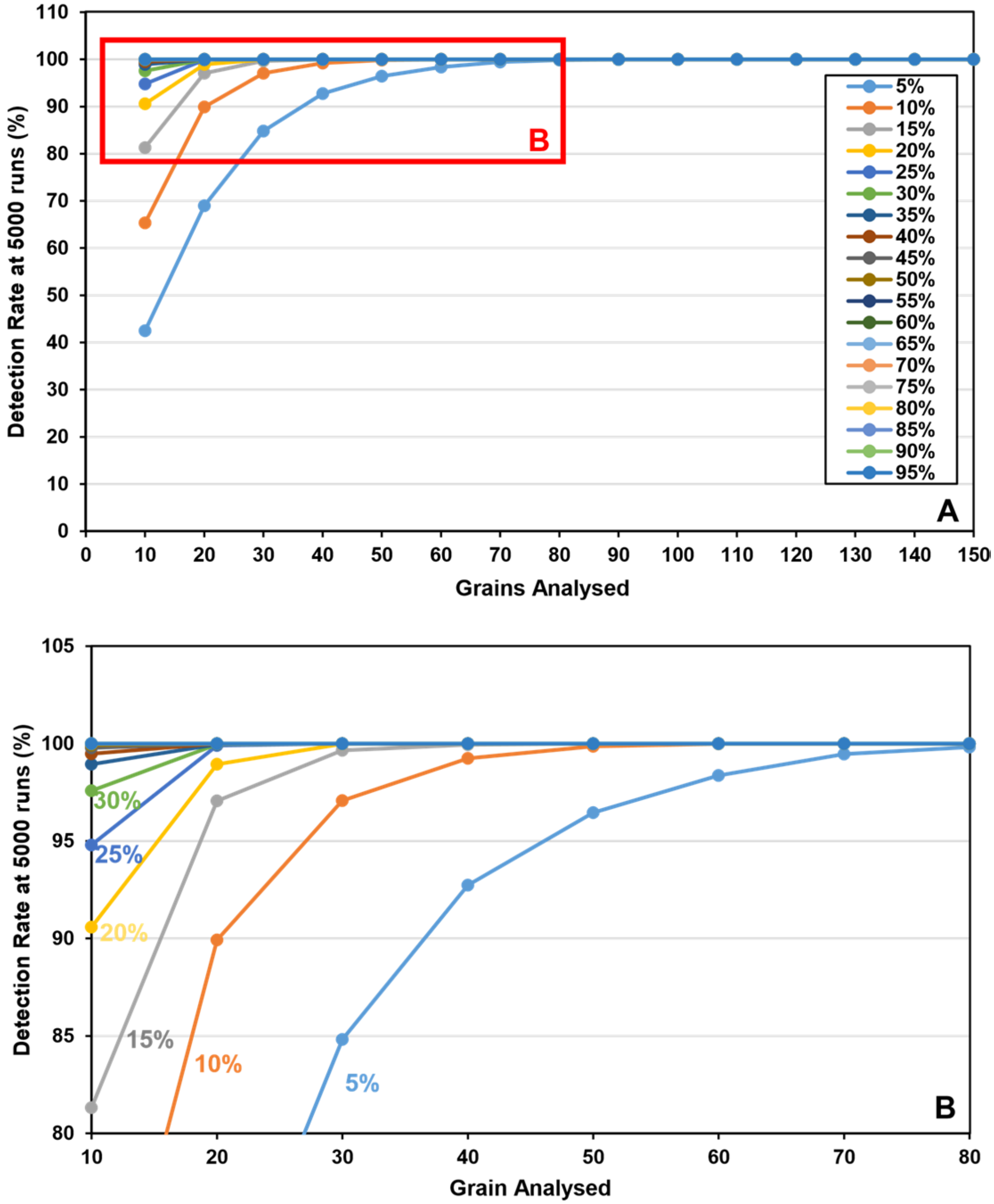

Figure S1.1 - Detection rates for Pb groups using 5000 random selections of a synthetic sample containing a total of 150 grains. Coloured lines represent abundance of the Pb group. Results indicate analysis of greater than 40 grains is required to detect a Pb group ≥6% in abundance with ≥94.58% confidence.

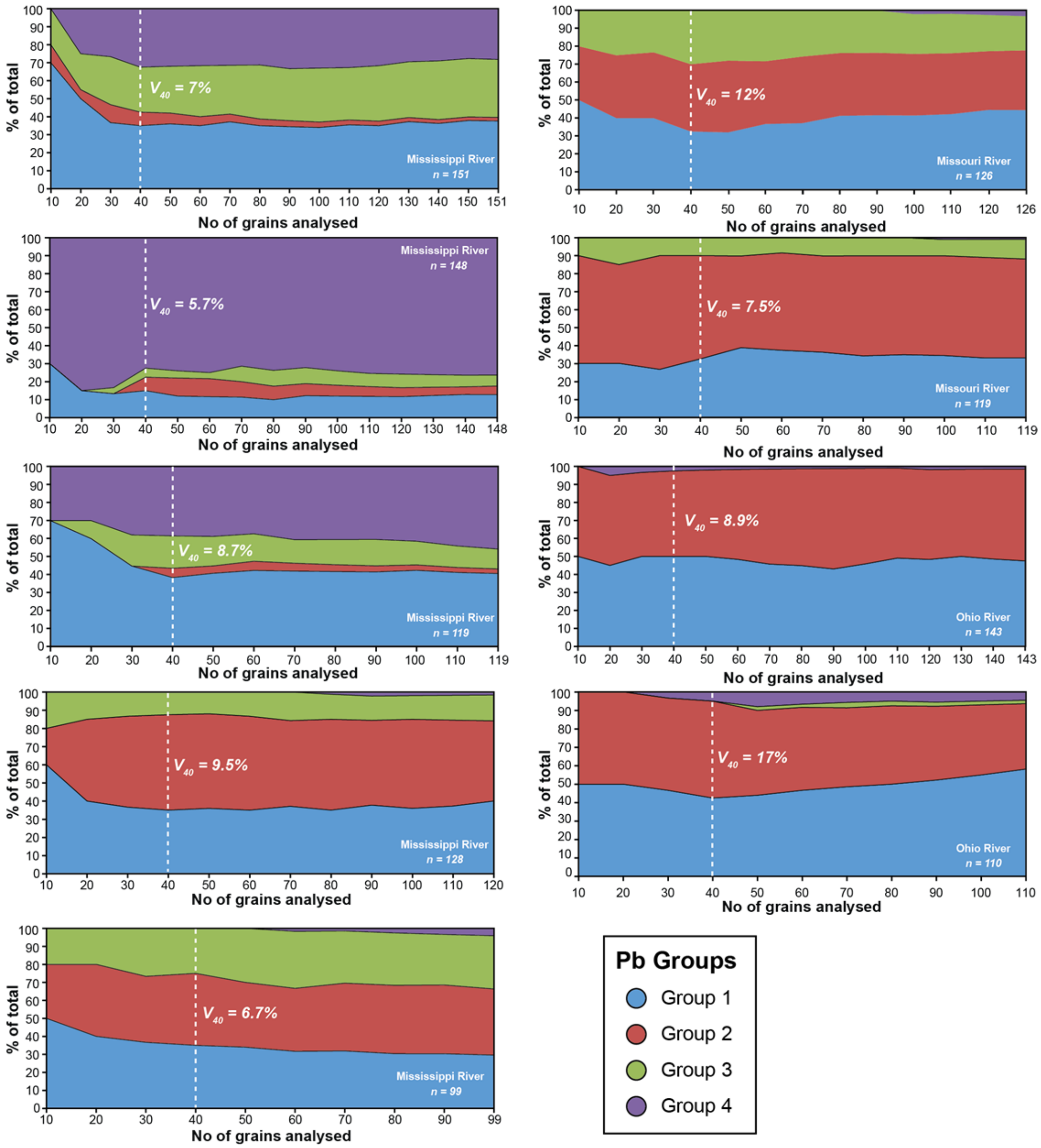

Figure S1.2 - Cumulative plots showing the proportions of Pb groups in order of analysis for nine samples across the Mississippi-Missouri drainage basin with up to 150 grains. V_{40} = maximum variation in relative abundance for any Pb group after 40 grains have been analysed. Exceeding analysis of 40 grains reveals a maximum variation of 17% for any single Pb group, with 7 out 9 samples showing <10% variation.

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SUPPLEMENTARY FILE DR3. Thorogenic Pb Plots

Figure 7 - Jurassic Thorogenic Pb isotopic compositions

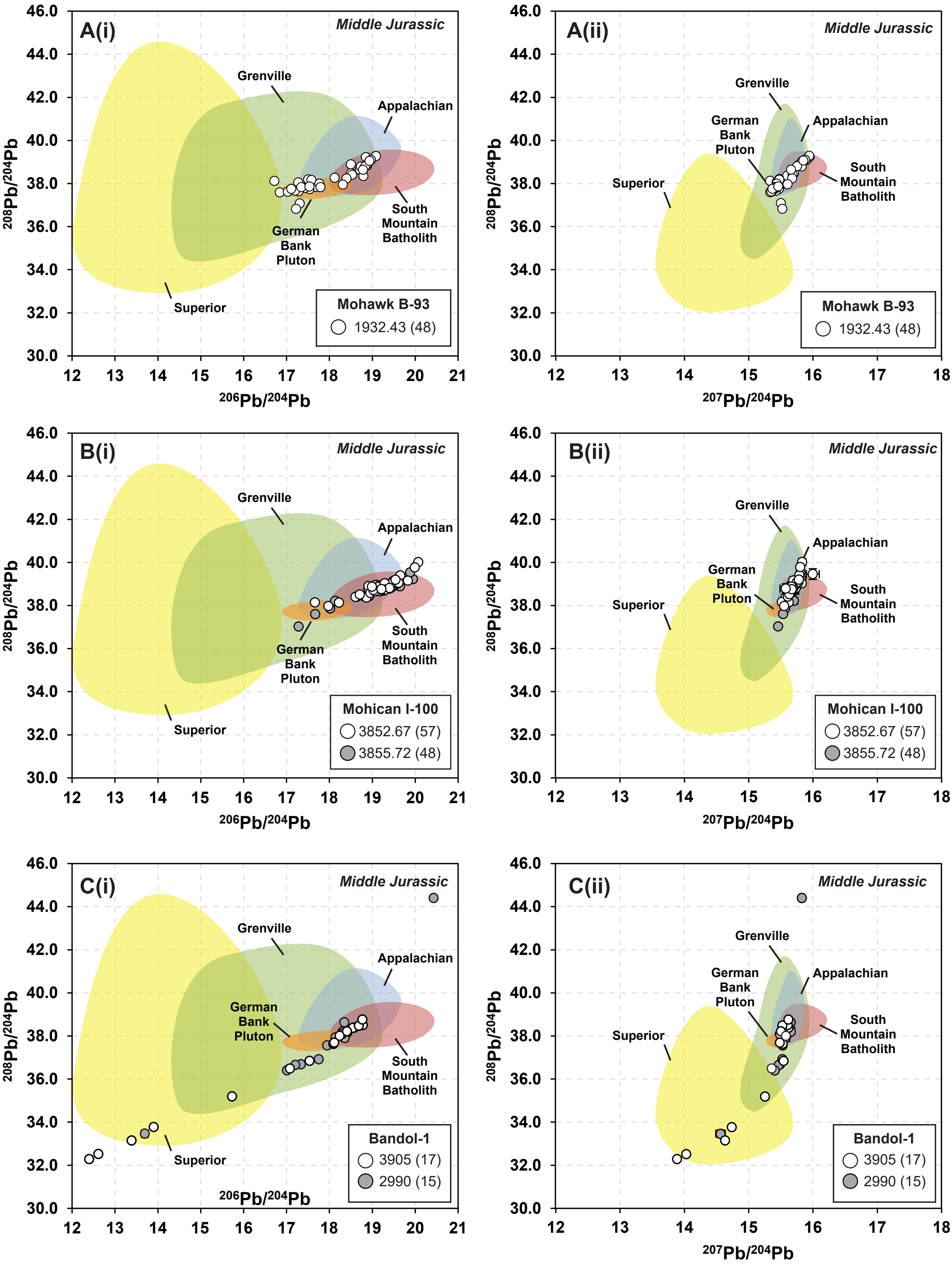

Figure 7 - Jurassic Thorogenic Pb isotopic compositions

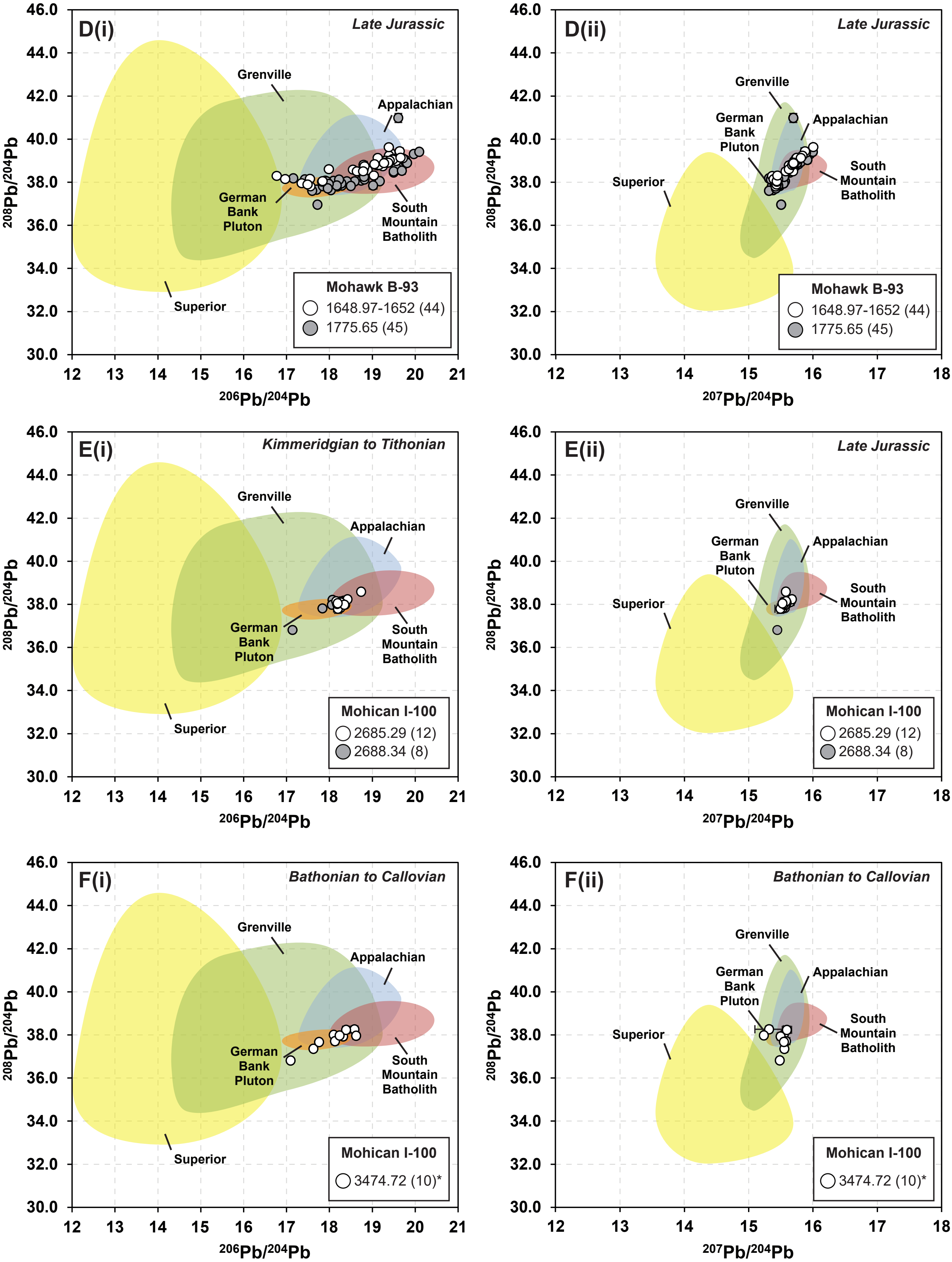

Figure 8 - Cretaceous Thorogenic Pb isotopic compositions

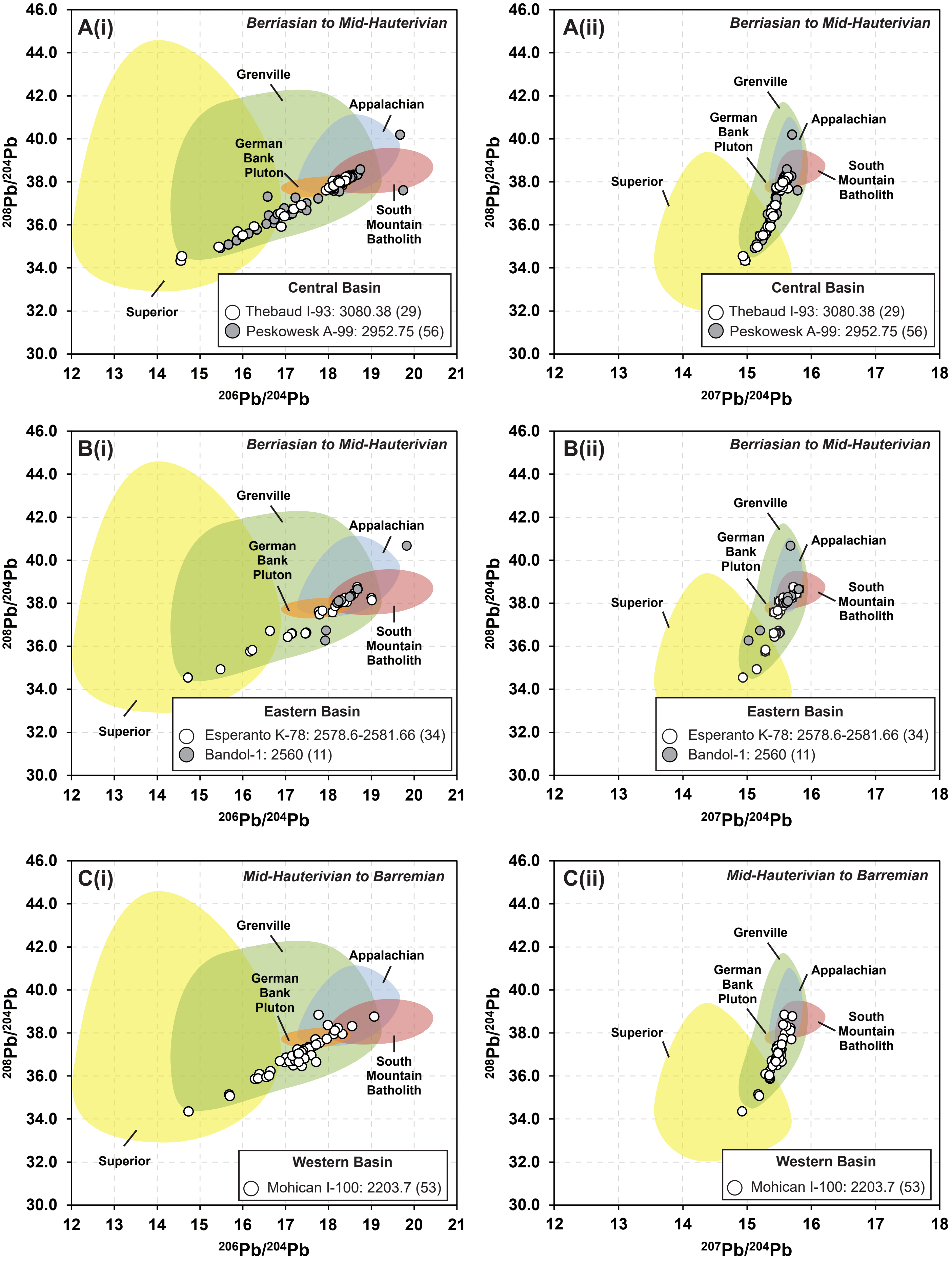

Figure 8 - Cretaceous Thorogenic Pb isotopic compositions

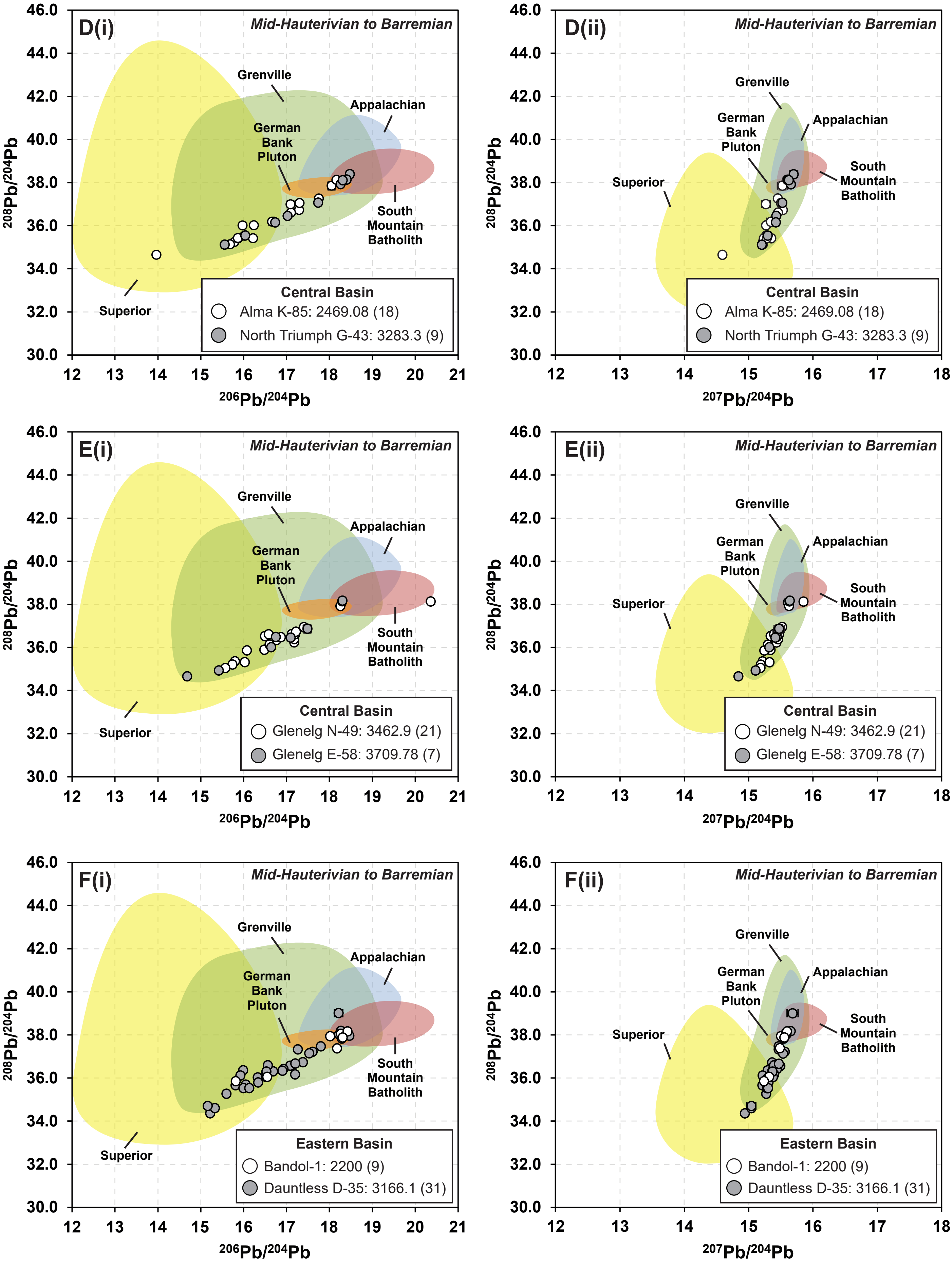

Figure 8 - Cretaceous Thorogenic Pb isotopic compositions