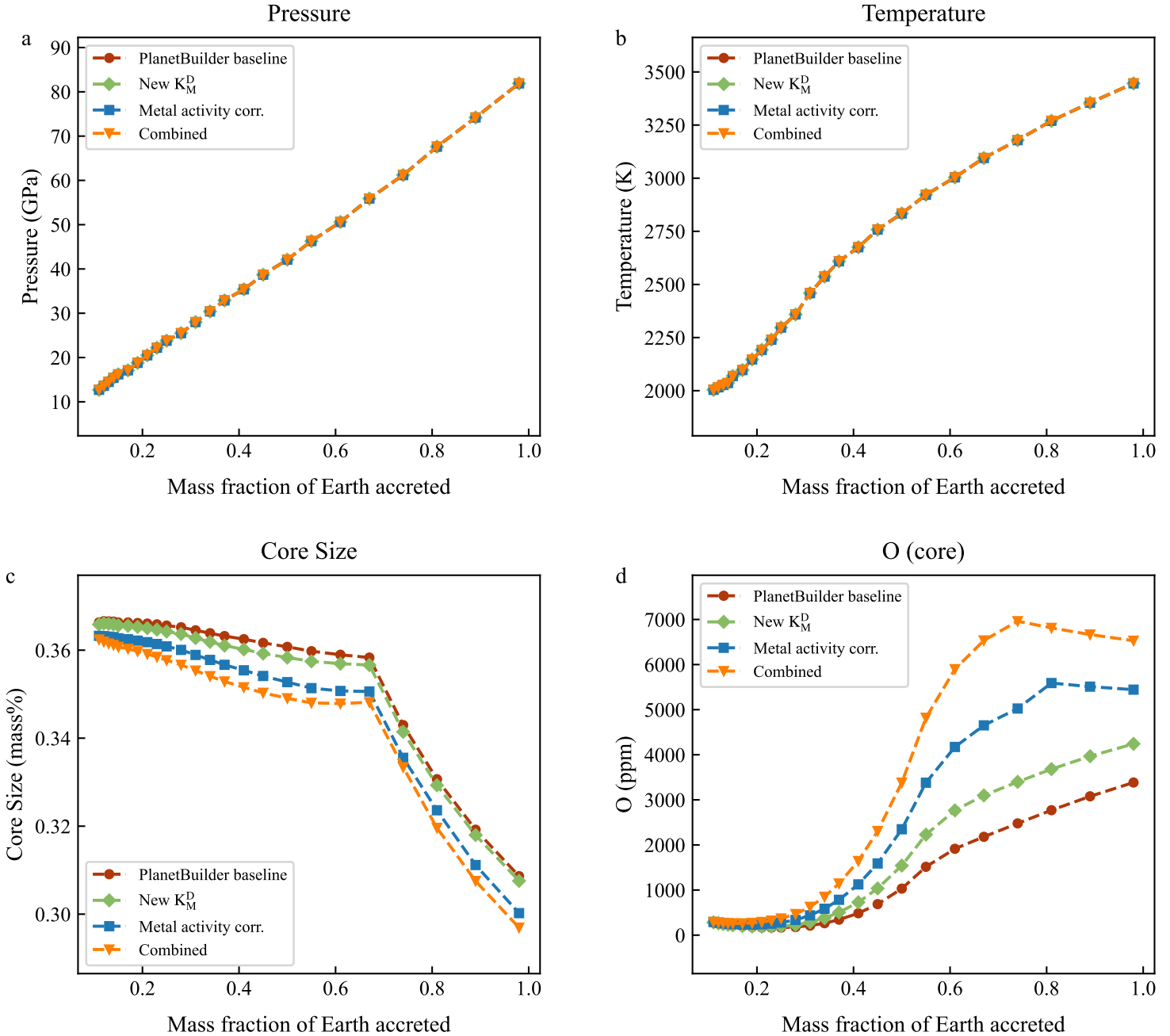
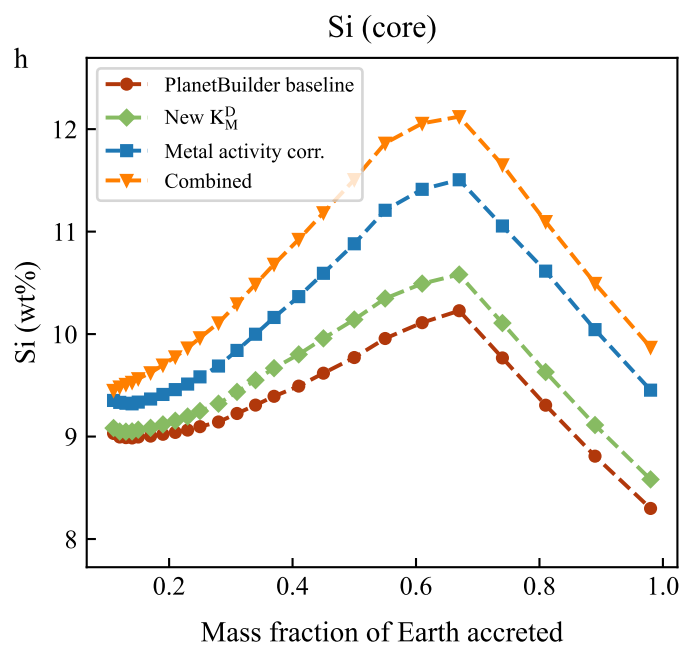
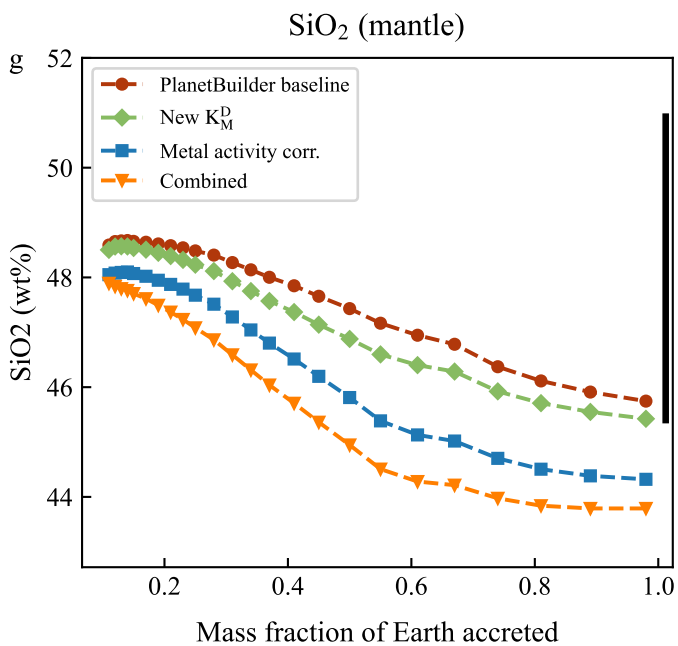
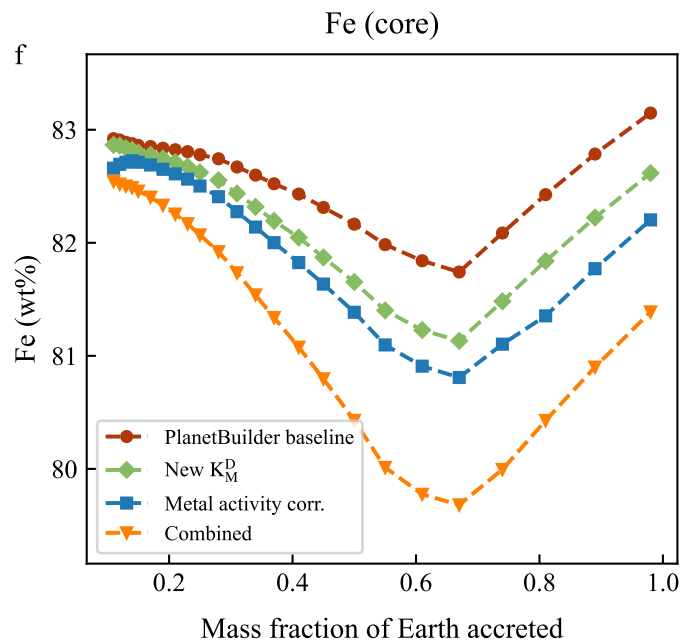
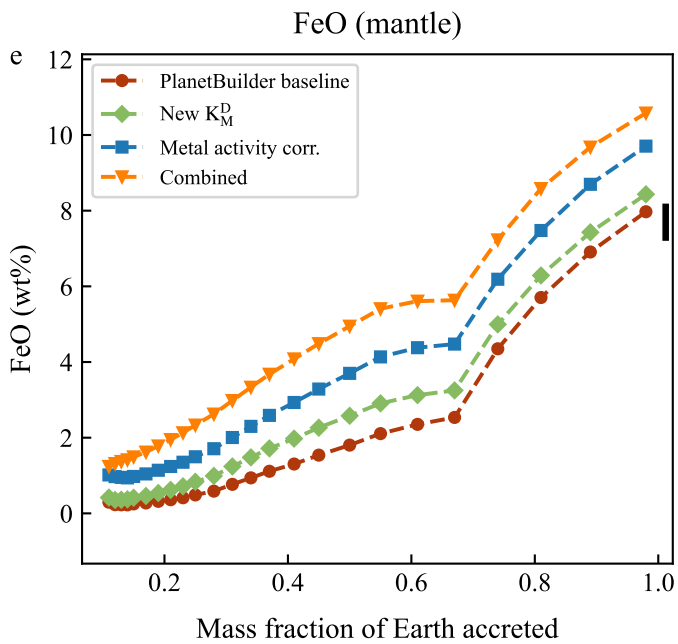
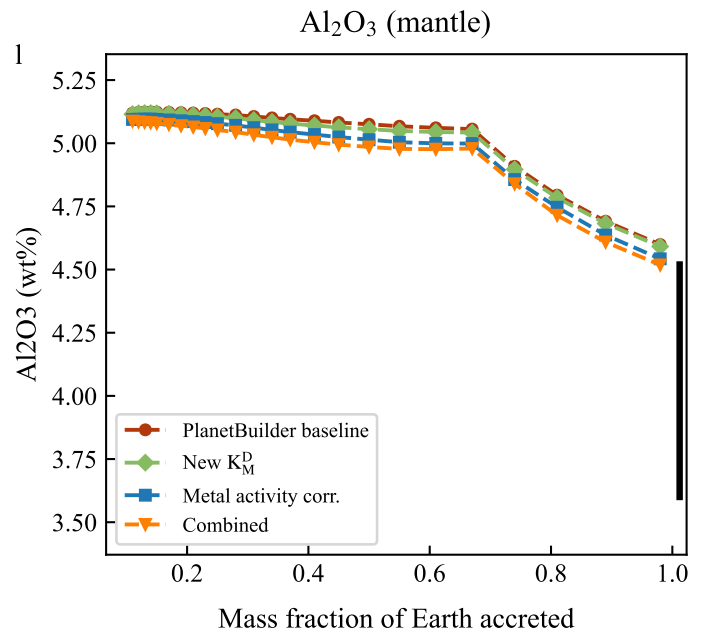
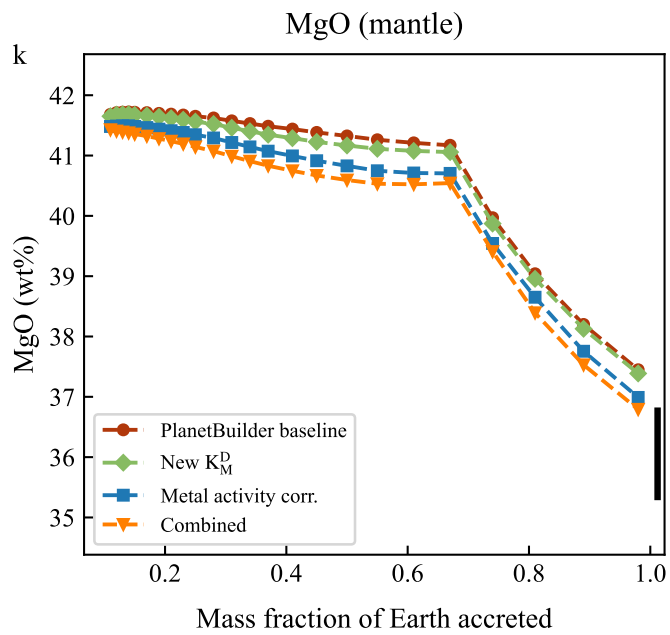
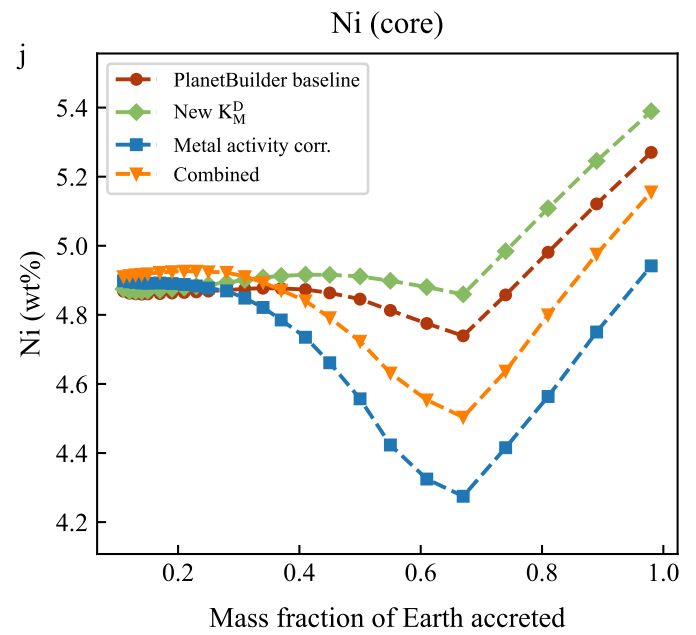
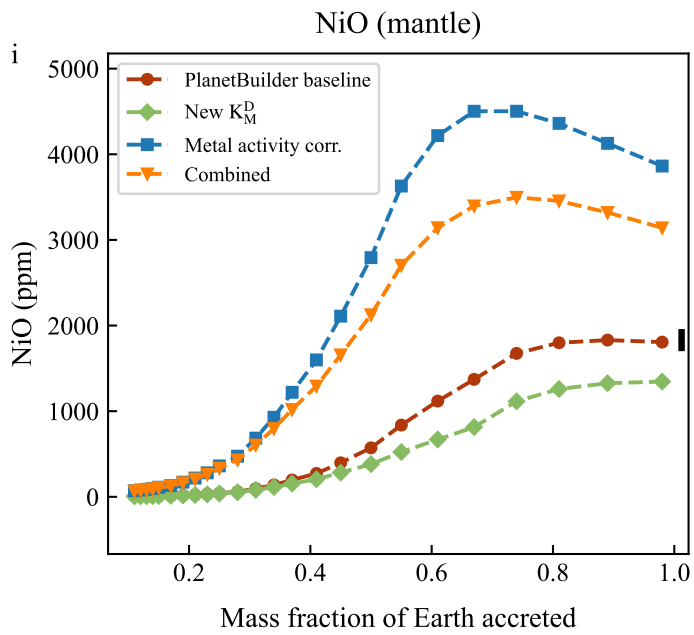


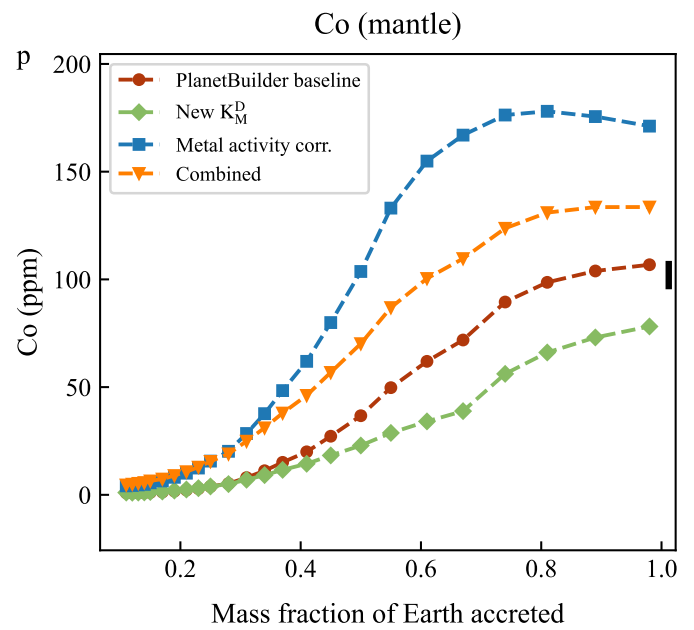
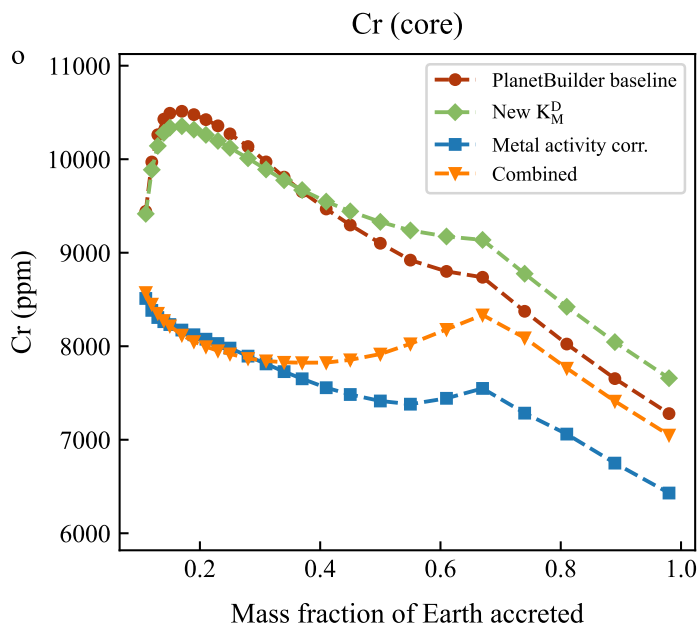
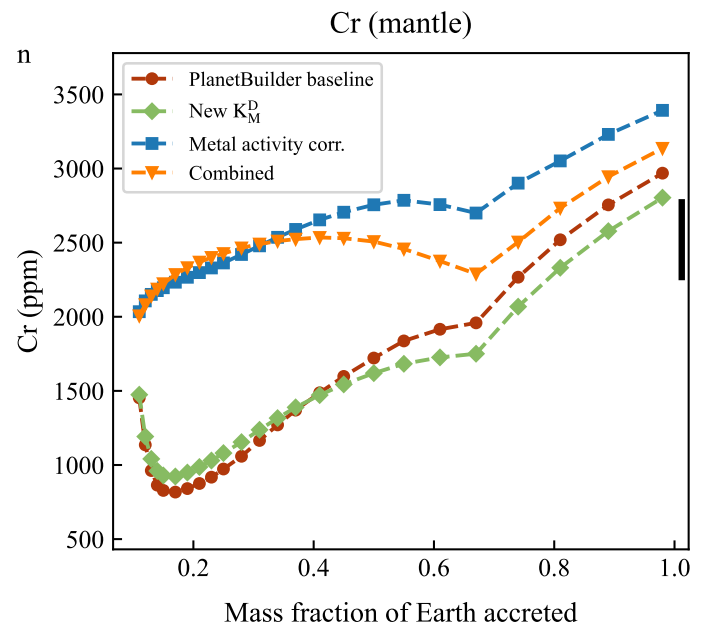
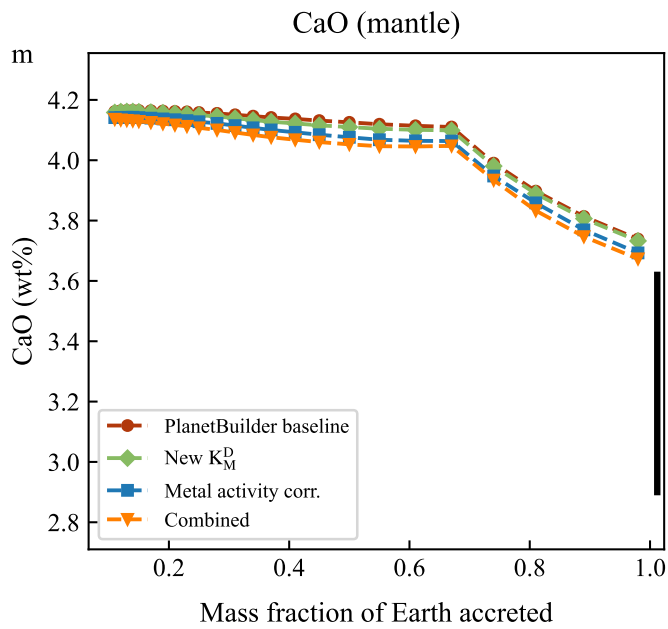
**Supplementary Material S.1 : Expanded version of Fig. 3, including all measured elements, conditions and partitioning data**

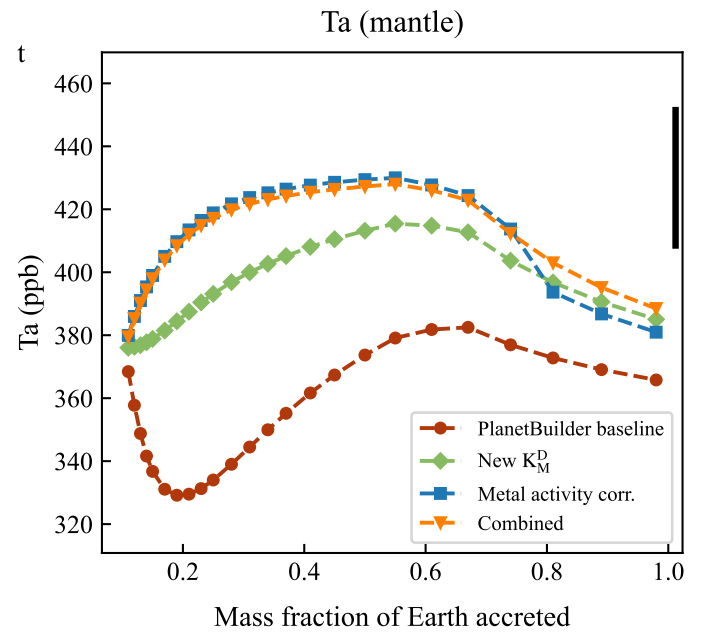
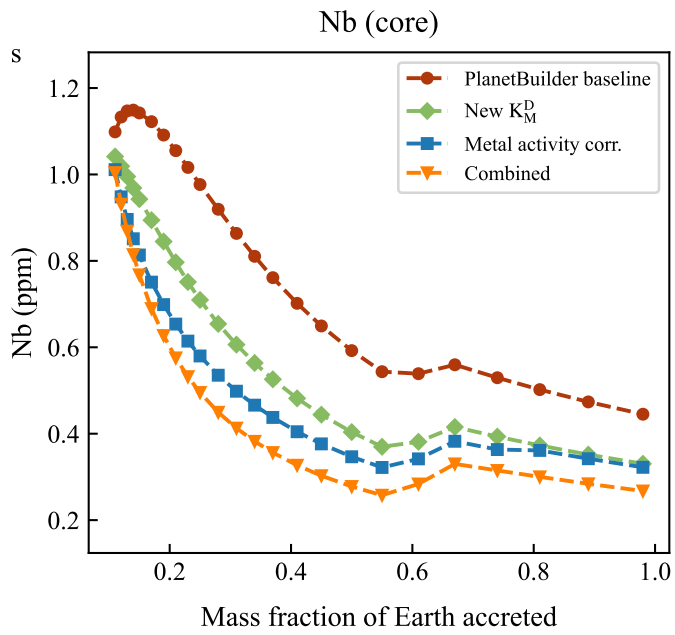
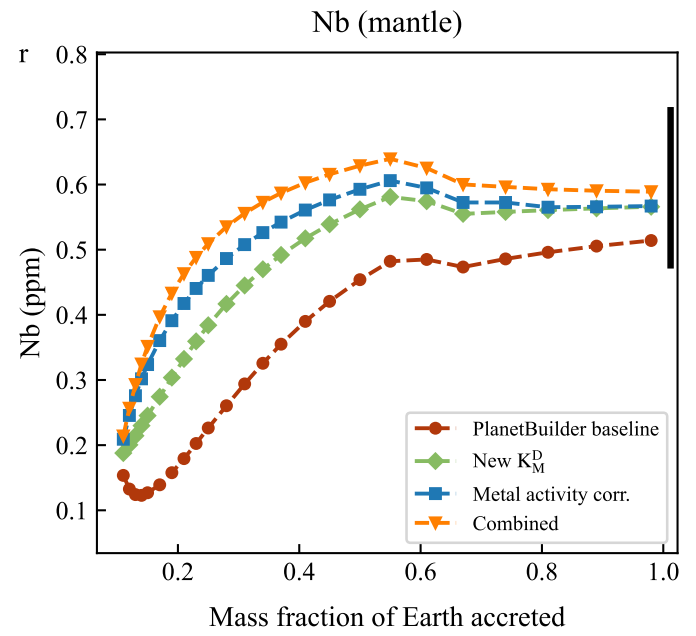
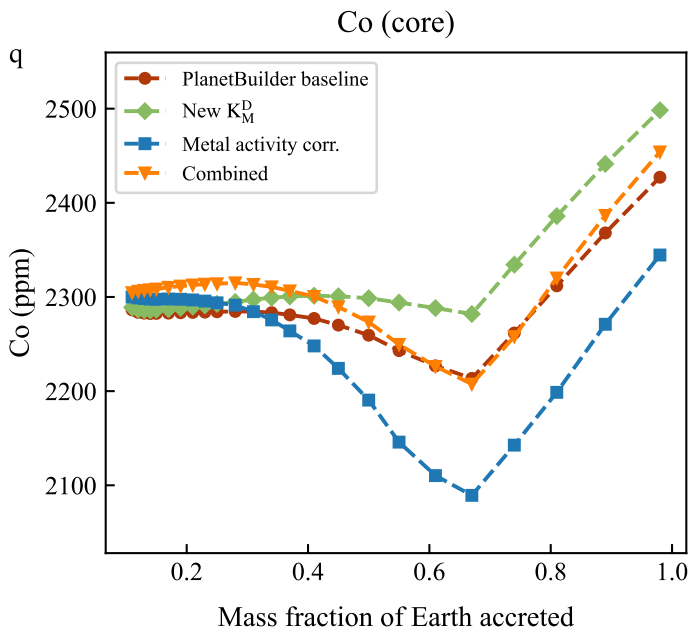
The different curves show the influence of metal activity, new  $K_M^D$  parameters and the combination of the two on the partitioning and concentrations of all measured elements, compared to the baseline model based on (Rubie et al., 2011). The black bars in the figures of the planetary mantle concentrations are estimates for the BSE (Palme and O'Neill, 2014).

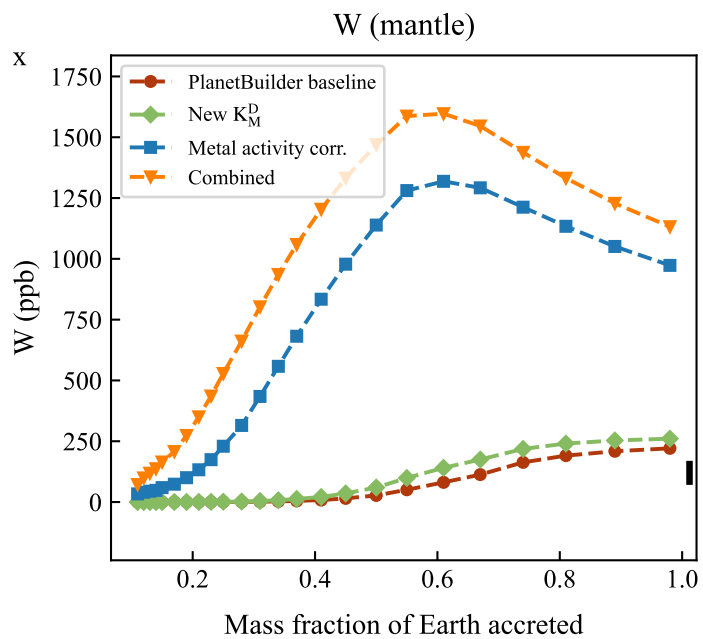
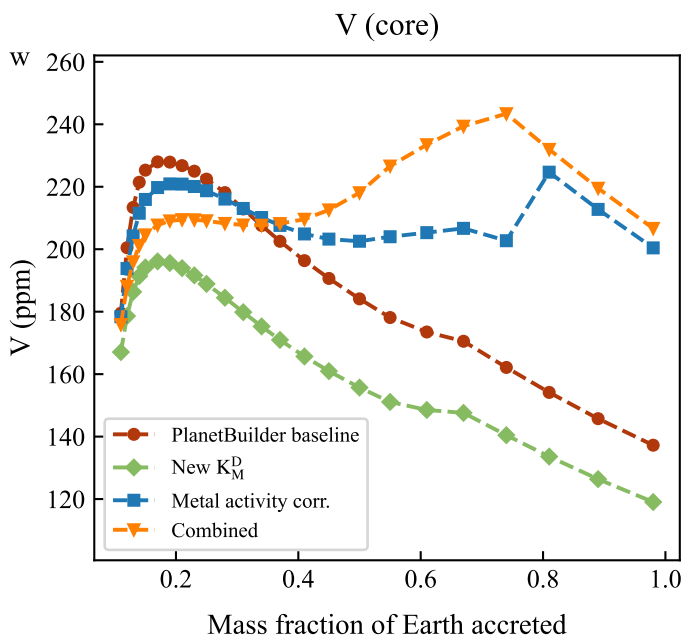
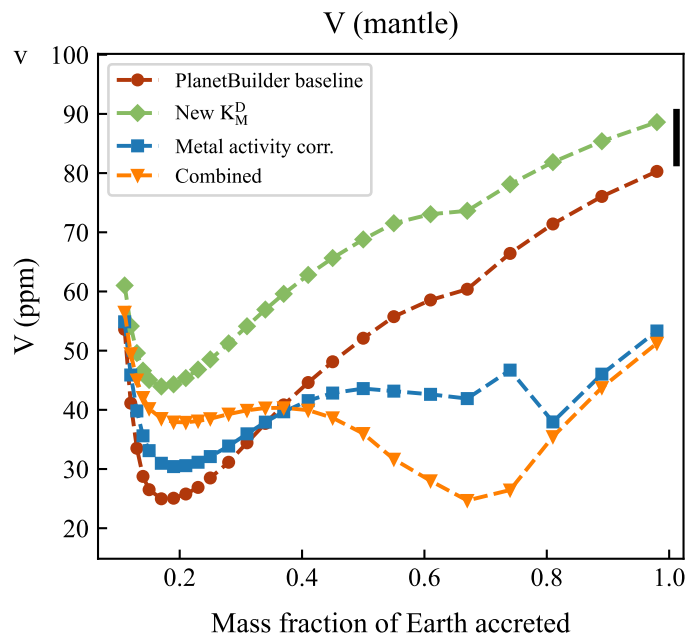
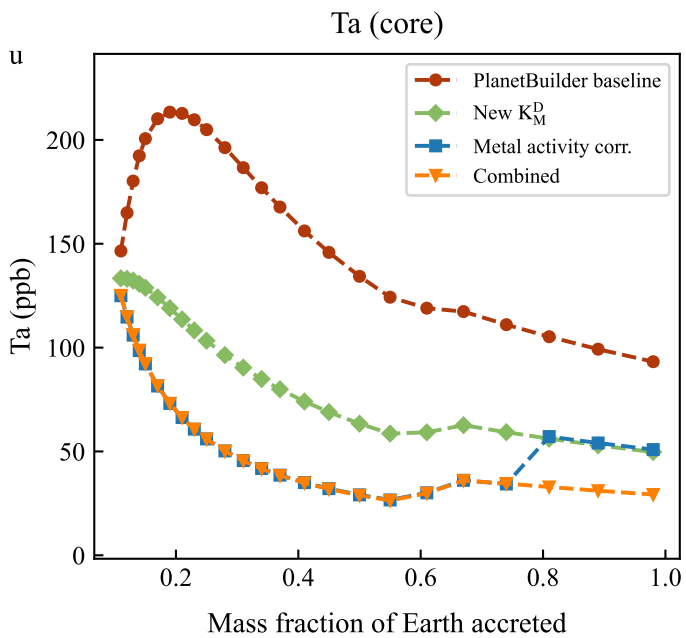


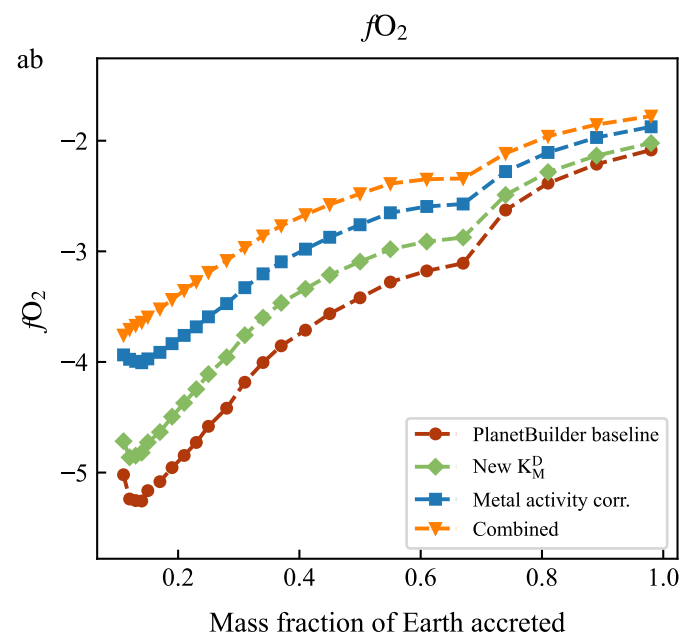
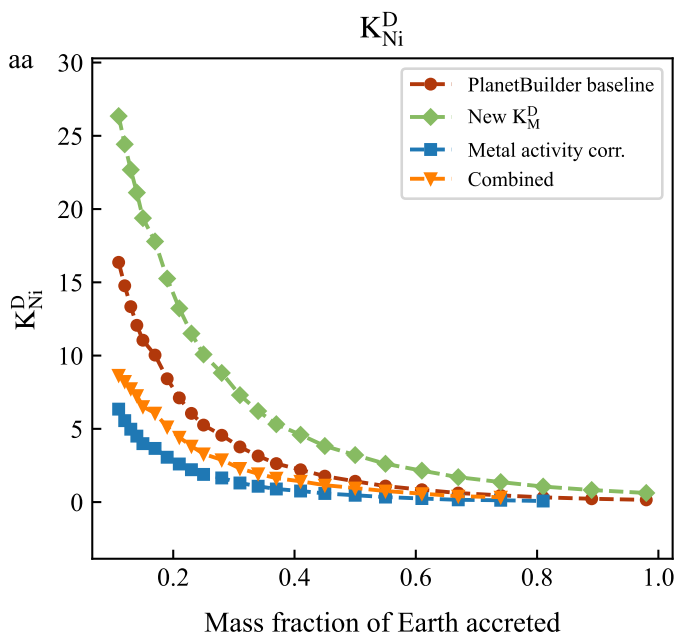
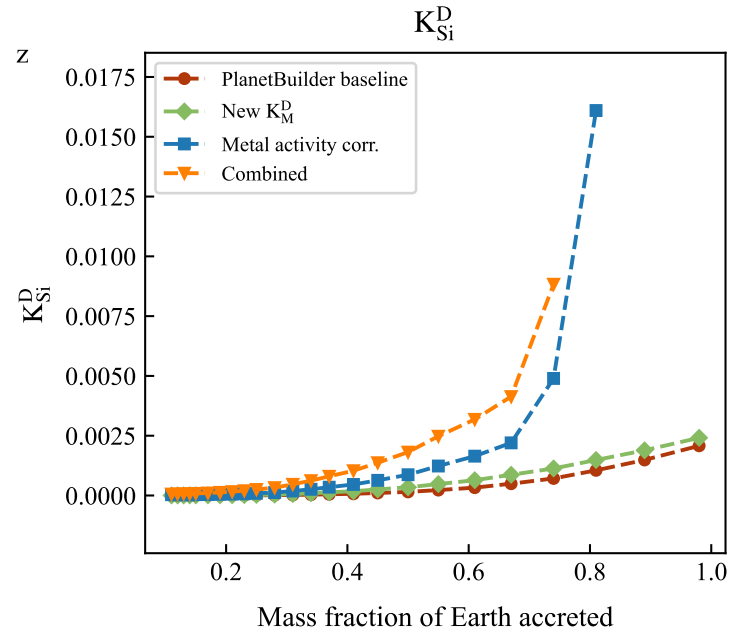
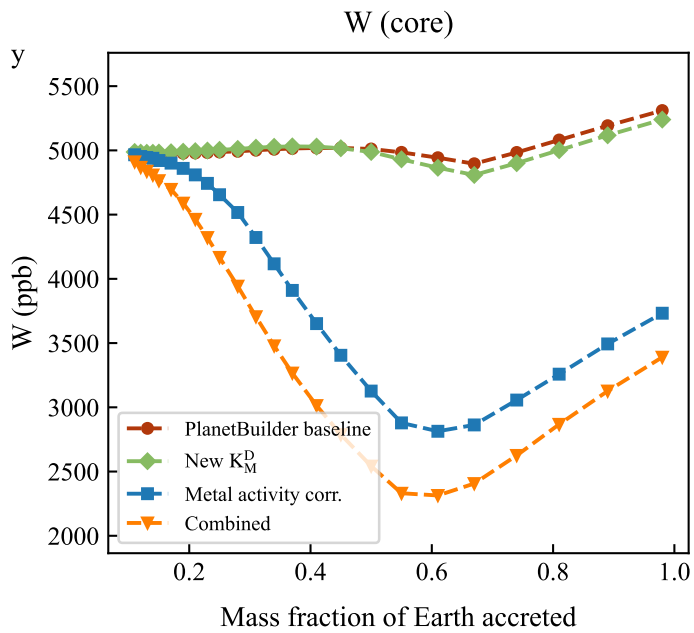












### Supplementary Material S.2 : Comparison PlanetBuilder implementation of 'HET-2' model with Rubie et al. (2011)

The minor differences between our implementation of the 'HET-2' model and the published data from Rubie et al. (2011) are primarily visible in the concentrations of Fe and O in the planetary core. As mentioned in the main text, there are two causes:

First of all, our program uses a more exact normalisation when converting the data from moles to concentration in ppm, including all elements of a phase instead of only the major elements which accounts for approximately 99mol%. This difference causes a slight shift in all concentrations, and is especially visible for Fe; the primary element in the planetary core with concentrations of > 81.5wt%.

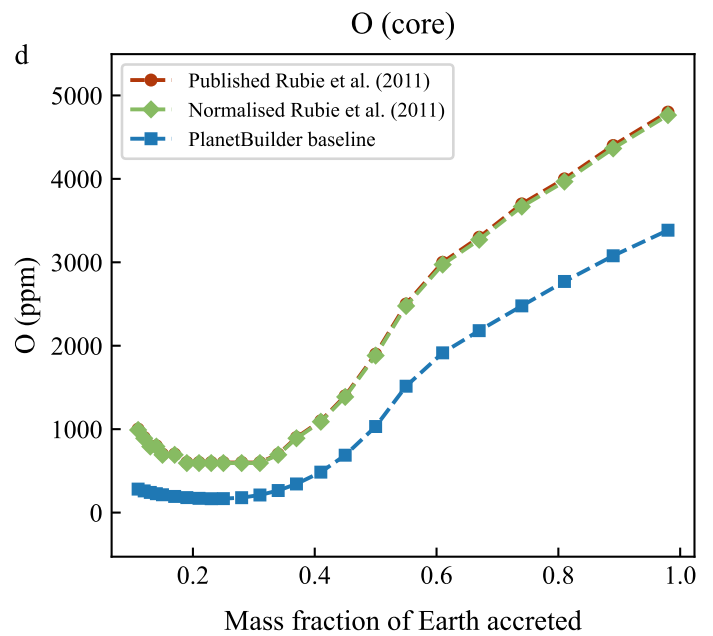
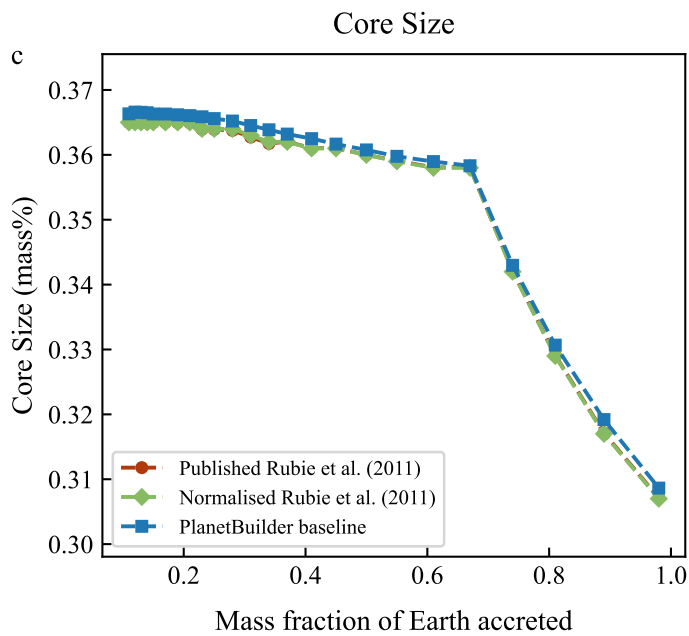
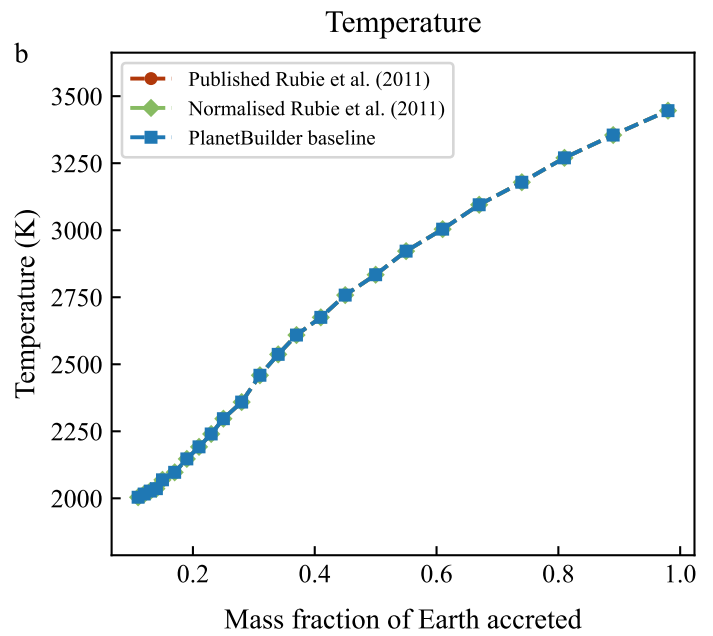
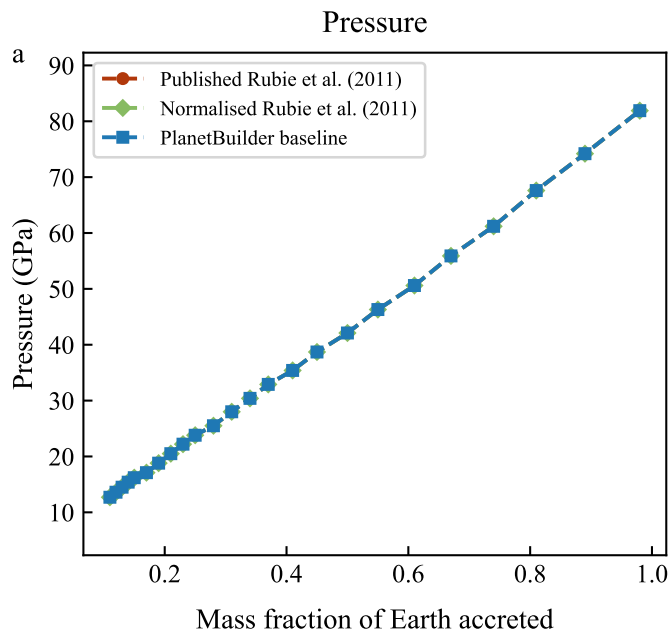
The second difference between the programs is the execution of the thermodynamic  $K_O^D$  calculations, noticeable in both Fe and O concentrations in the planetary core. As explained in the main text: the concentration of FeO in the impactor core ( $x_{FeO}^{metal}$ ) is used as a variable to derive the chemical potential (Eq. 46). However, the last term of Eq. (46) for the impactor core is calculated by the asymmetric Margules equations as shown in Eq. (6) from Frost et al. (2010):

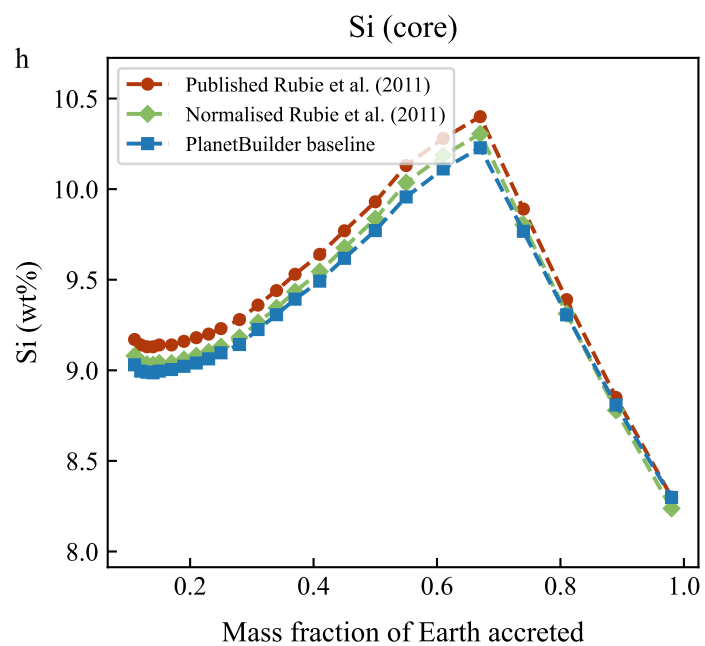
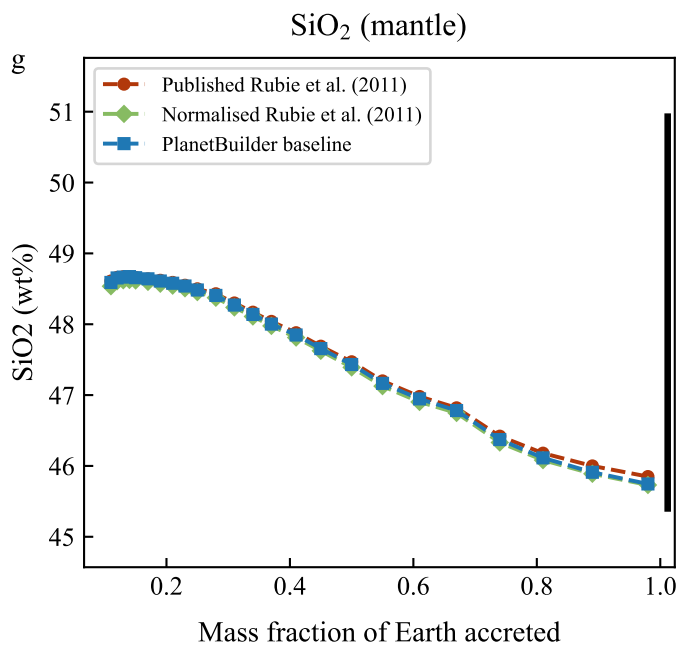
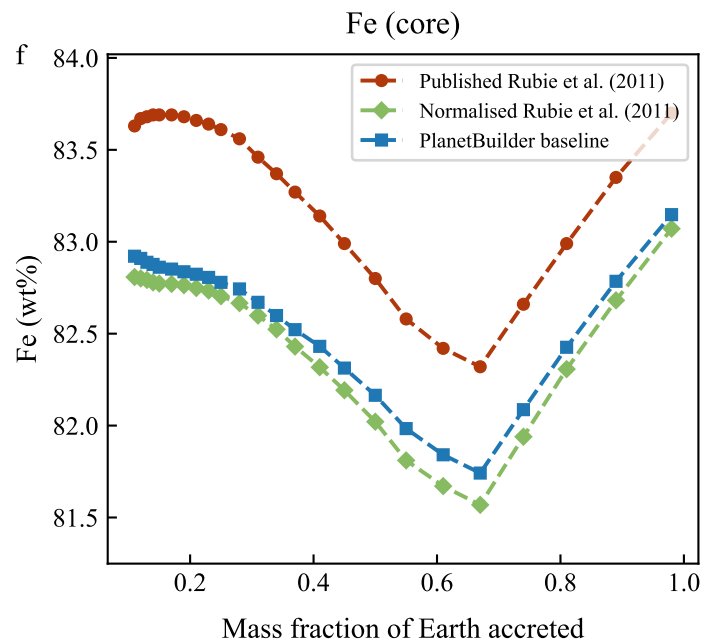
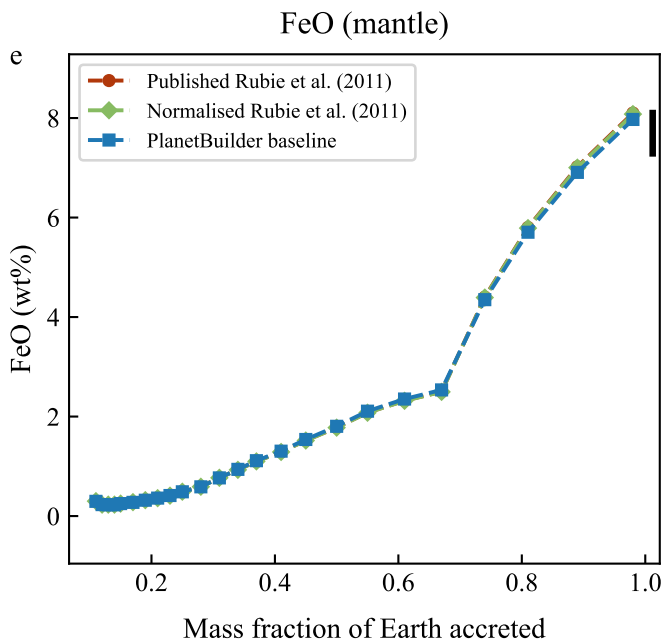
$$RT\ln(\gamma_{FeO}^{metal}) = (1 - x_{FeO}^{metal})^2(W_{FeO-Fe} + 2(W_{Fe-FeO} - W_{FeO-Fe})x_{FeO}^{metal}) \quad (S.1)$$

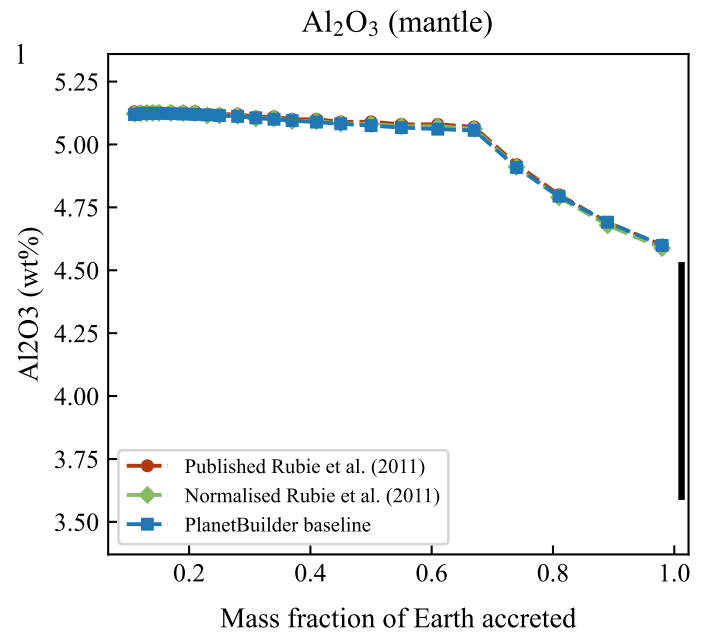
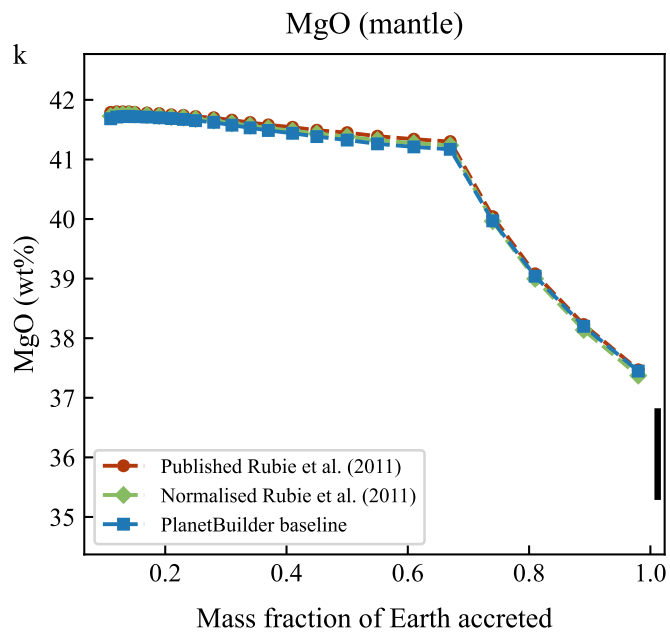
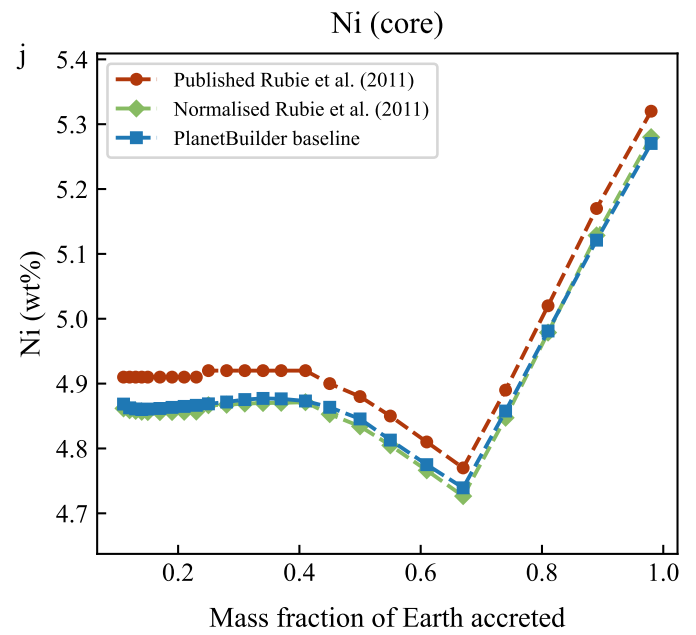
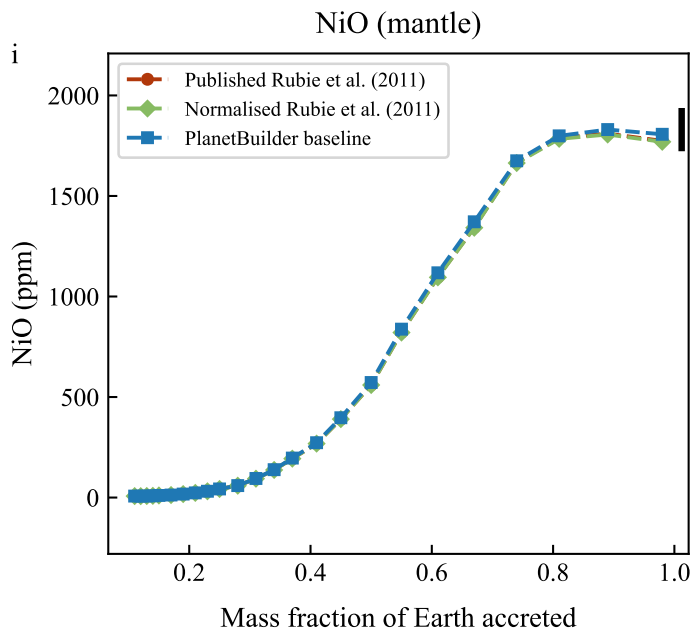
where  $W_{Fe-FeO}$  and  $W_{FeO-Fe}$  are interaction parameters as detailed in Frost et al. (2010). In Rubie et al. (2011) this equation was adjusted to:

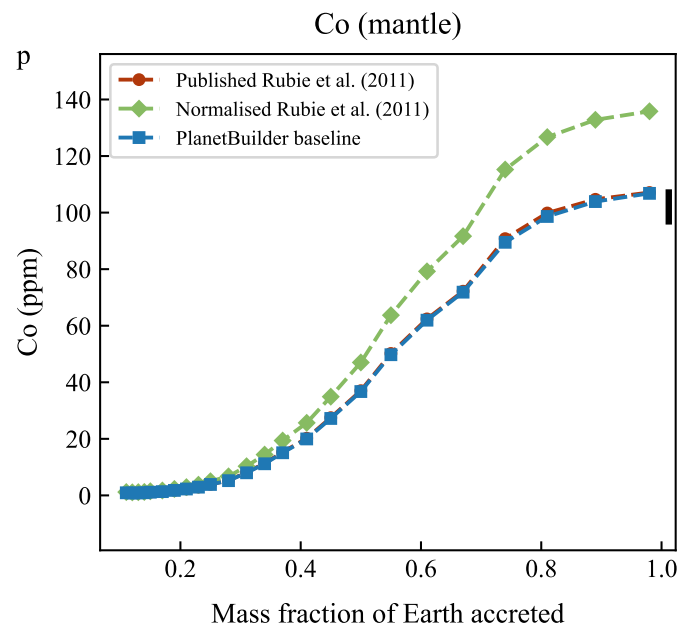
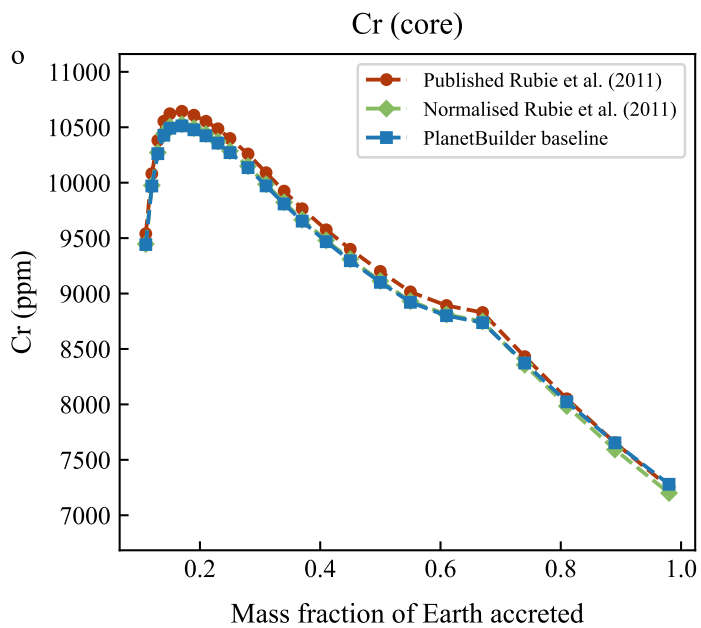
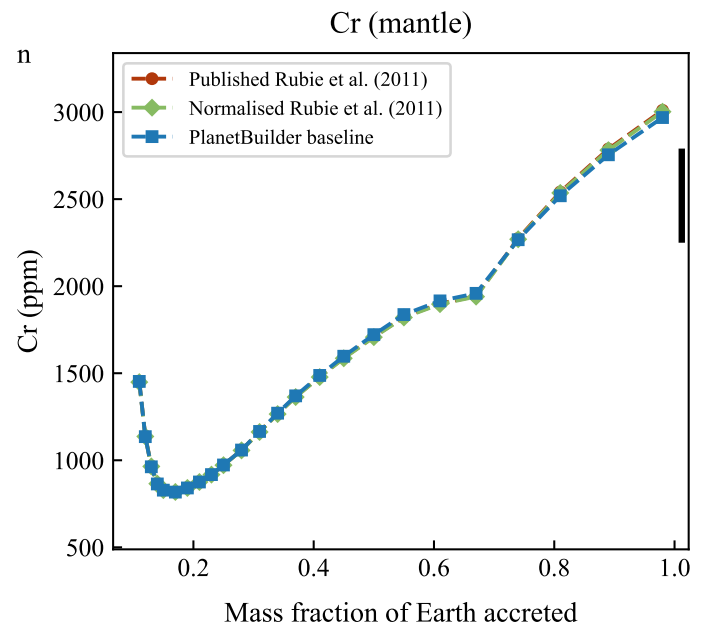
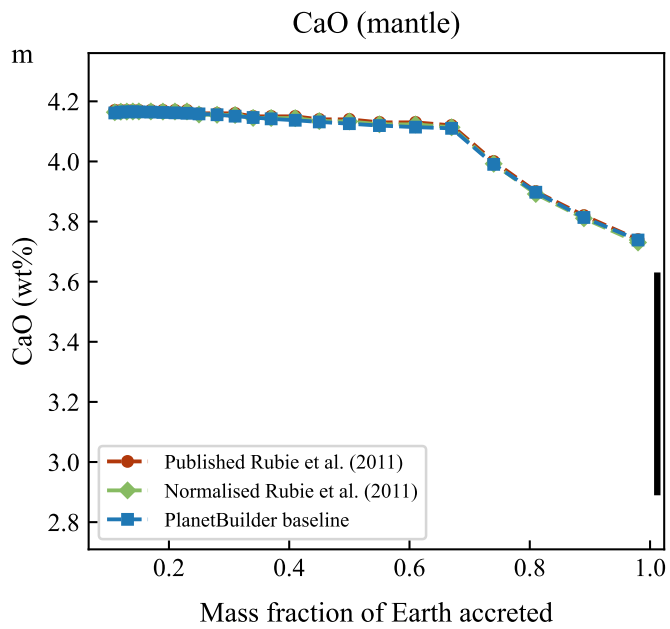
$$RT\ln(\gamma_{FeO}^{metal}) = (1 - x_{Fe}^{metal})^2(W_{FeO-Fe} + 2(W_{Fe-FeO} - W_{FeO-Fe})x_O^{metal}) \quad (S.2)$$

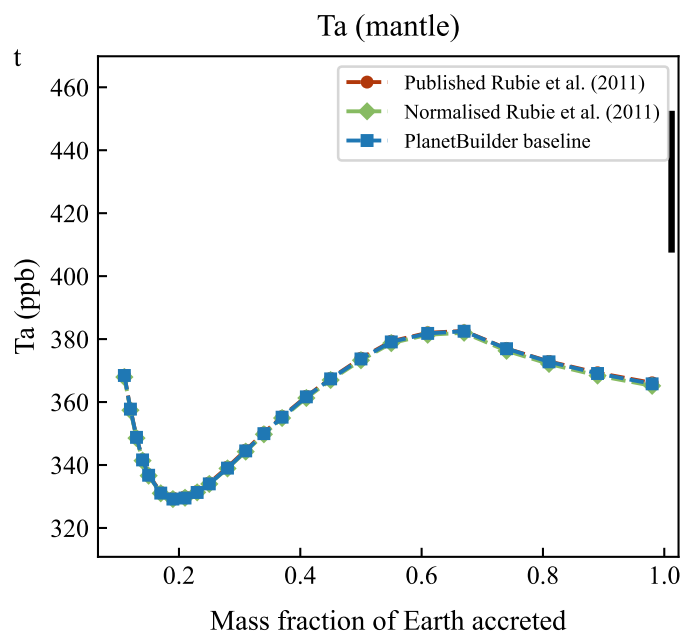
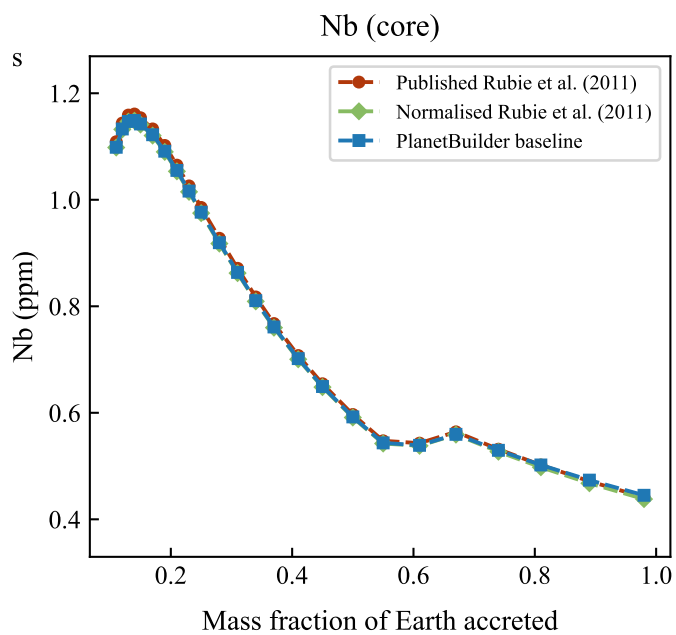
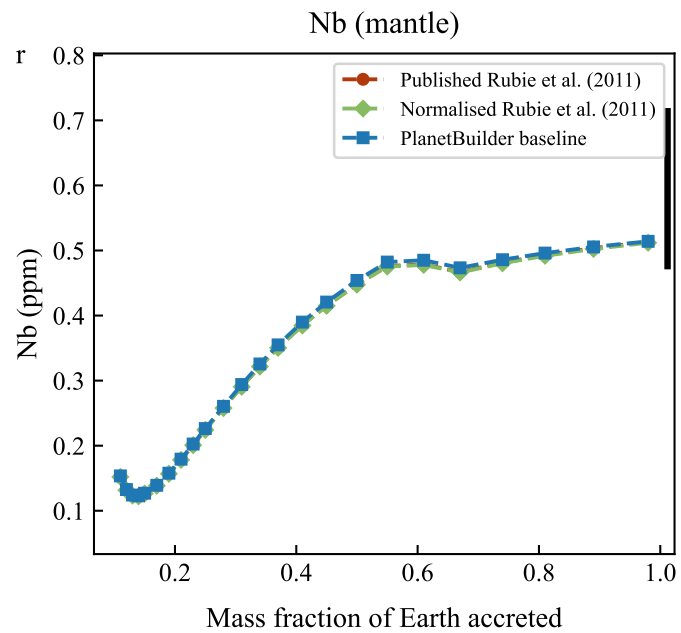
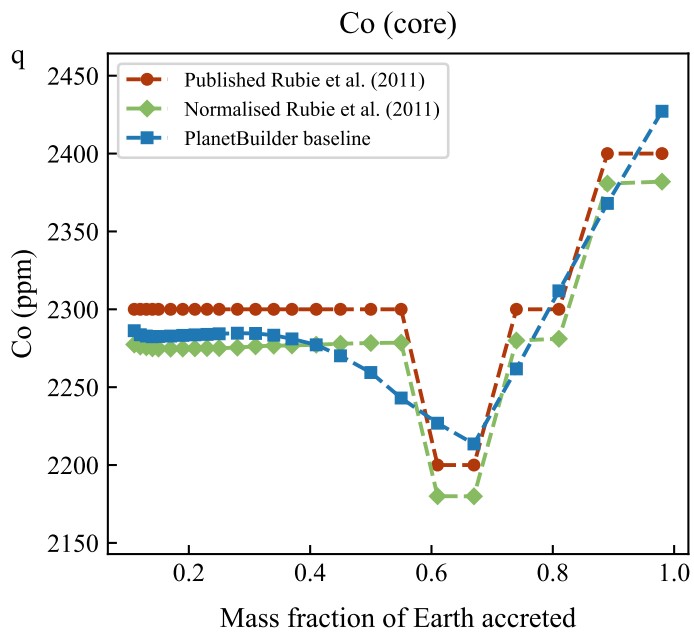
This reduces Eq. (6) from Frost et al. (2010) to a constant as  $x_{Fe}^{metal}$  and  $x_O^{metal}$  do not change during the calculations, and the only  $x_{FeO}^{metal}$  variable remaining is in Eq. (46). Using this approximation for the thermodynamic  $K_O^D$  makes it easier to calculate and avoids the use of a more complicated solver. In later versions of the Rubie et al. (2011) model, this simplification was removed and Eq. S.1 was used instead of Eq. S.2 (e.g. Rubie et al., 2015).

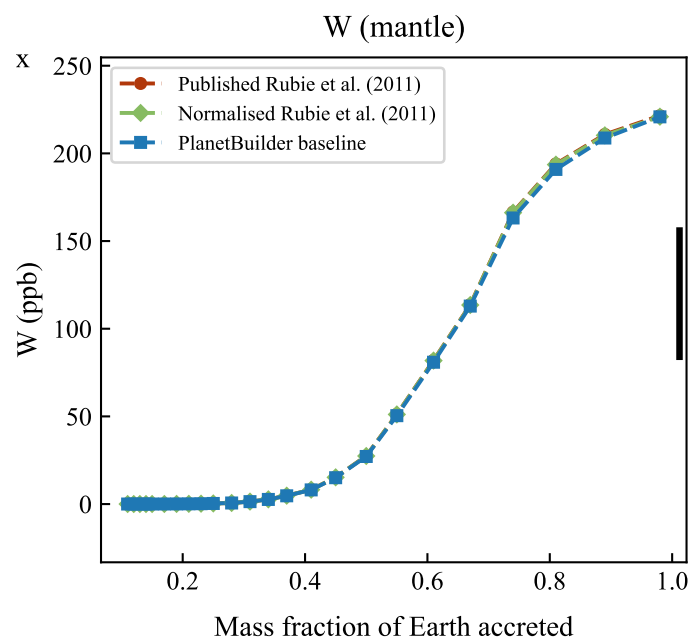
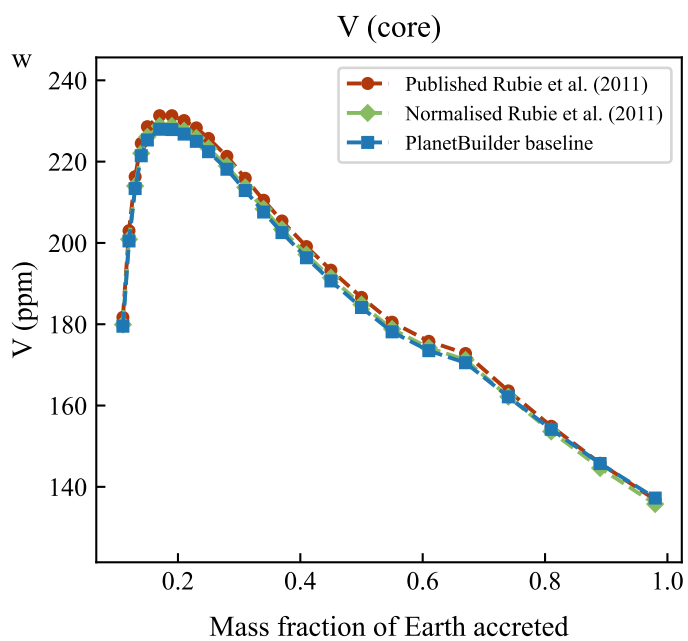
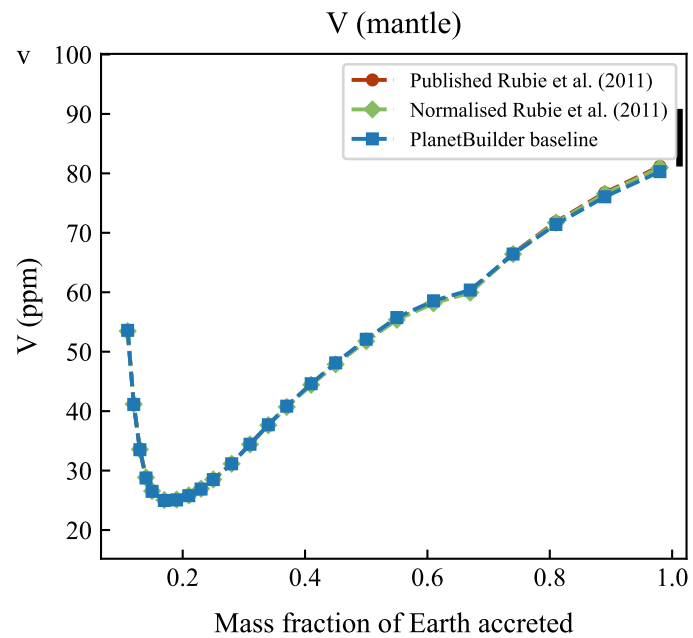
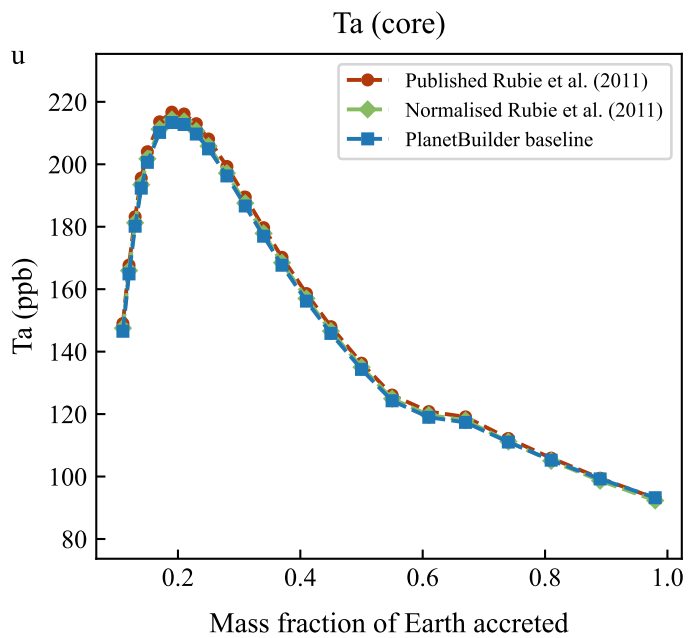


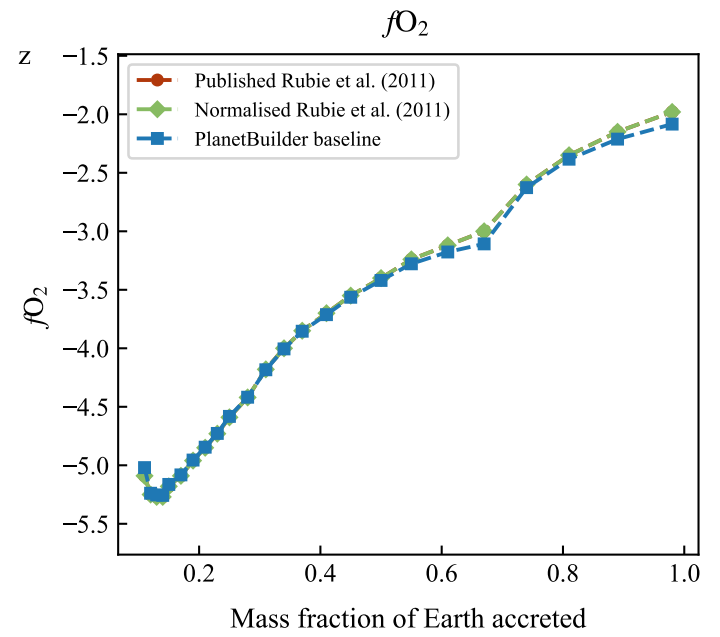
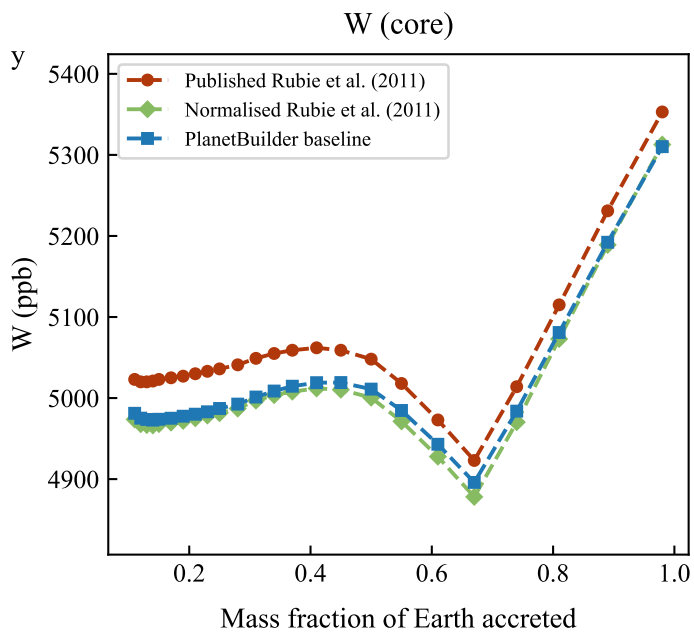












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