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Interactive comment on "Resolving the timescales of magmatic and hydrothermal processes associated with porphyry deposit formation using zircon U-Pb petrochronology" *by* Simon J. E. Large et al.

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We thank F. Corfu for his detailed comments on our submitted manuscript. We provide answers to the main comments of the reviewer and have addressed all of his valid points in the annotated manuscript.

(1) Assumptions associated with the interpretation of an emplacement age.

We thank the reviewer for the valid point that the reasoning for the interpretation of the youngest U-Pb dates as the porphyry emplacement ages should be made earlier. As

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pointed out in the manuscript annotated by the reviewer it was previously in lines 578 – 579 in the methods section. We have added the reasoning with a bit more detail to section 4.3 “CA-ID-TIMS geochronology”. Porphyry intrusions are volumetrically minor sub-volcanic intrusions and are considered to cool rapidly upon emplacement. It is thus assumed that most, if not all, zircons crystallise in the underlying magma reservoir resulting in the extended timescales of zircon crystallisation. Zircon is considered a low temperature phase crystallising until reaching the solidus the youngest recorded zircon and thus records the full crystallisation of the intrusions. The individual uncertainty of a zircon date is sufficient to account for the timescales of porphyry cooling (<10 kyr; e.g. Cathles, 1977).

(2) Reproducibility of young CA-ID-TIMS data

We thank the reviewer for outlining the high quality of the presented data. Indeed, we are measuring very low quantities of Pb. However, we are convinced that the results are reproducible. The zircon standards referred to and referenced in the manuscript (Aus_Z7_5, von Quadt et al., 2016) contain similarly low amounts of radiogenic Pb (0.5 – 4 pg), are of similar age (2.41 Ma) and most importantly are reproducible on the kyr scale.. These were analysed over the same time interval, under the same conditions and in the same lab as the zircons analysed for this study. And these measurements A more indirect assurance that our data is reproducible is that timescales of zircon crystallisation appear to be remarkably similar for studies on porphyry deposits not only conducted in this lab, but also in other labs (Fig. 8). These studies have been conducted on deposits of variable age and thus on zircons with hugely variable radiogenic Pb contents. Finally, the sequence of youngest ages matches the geological emplacement sequence, despite the much larger range of older zircons in each sample; an observation that holds for every single case of several other deposits we studied with this approach. This systematics would be impossible to explain if the age variations were analytical artefacts, and it a also corroborates our interpretation of the youngest zircon in each sample being close to the age of emplacement and magma quenching

and termination of zircon crystallization.

(3) Discussion TIMS vs. in-situ data

We appreciate the reviewer outlining the low precision of the individual LA-ICP-MS dates and SHRIMP dates. We also appreciate the positivity of Reviewer #2 regarding this section. The main point of this section is not that the LA-ICP-MS dates further define the geological interpretation, in which case they could be considered unnecessary. However, we compare the three most commonly applied U-Pb techniques on zircons from the same samples and in the case of TIMS and LA-ICP-MS on the same zircon grains. From this comparison (of a type that has, to our knowledge, not been published before), we can show (1) that the large number of young low precision LA-ICP-MS dates is remarkably accurate as a bulk data-set but that (2) the calculation of the weighted mean and the standard error from LA-ICP-MS populations as currently practiced in the copious literature needs more careful consideration. Using weighted means on such young data-sets as estimates for any geological event or process can result in highly precise dates without any geological significance. We therefore believe that this discussion is of interest to a broad readership. We tried to shorten the section and to focus on our main points and hope that the reviewer and editor can accept the revised section.

With best regards, Simon Large et al.

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