

Fig. S1

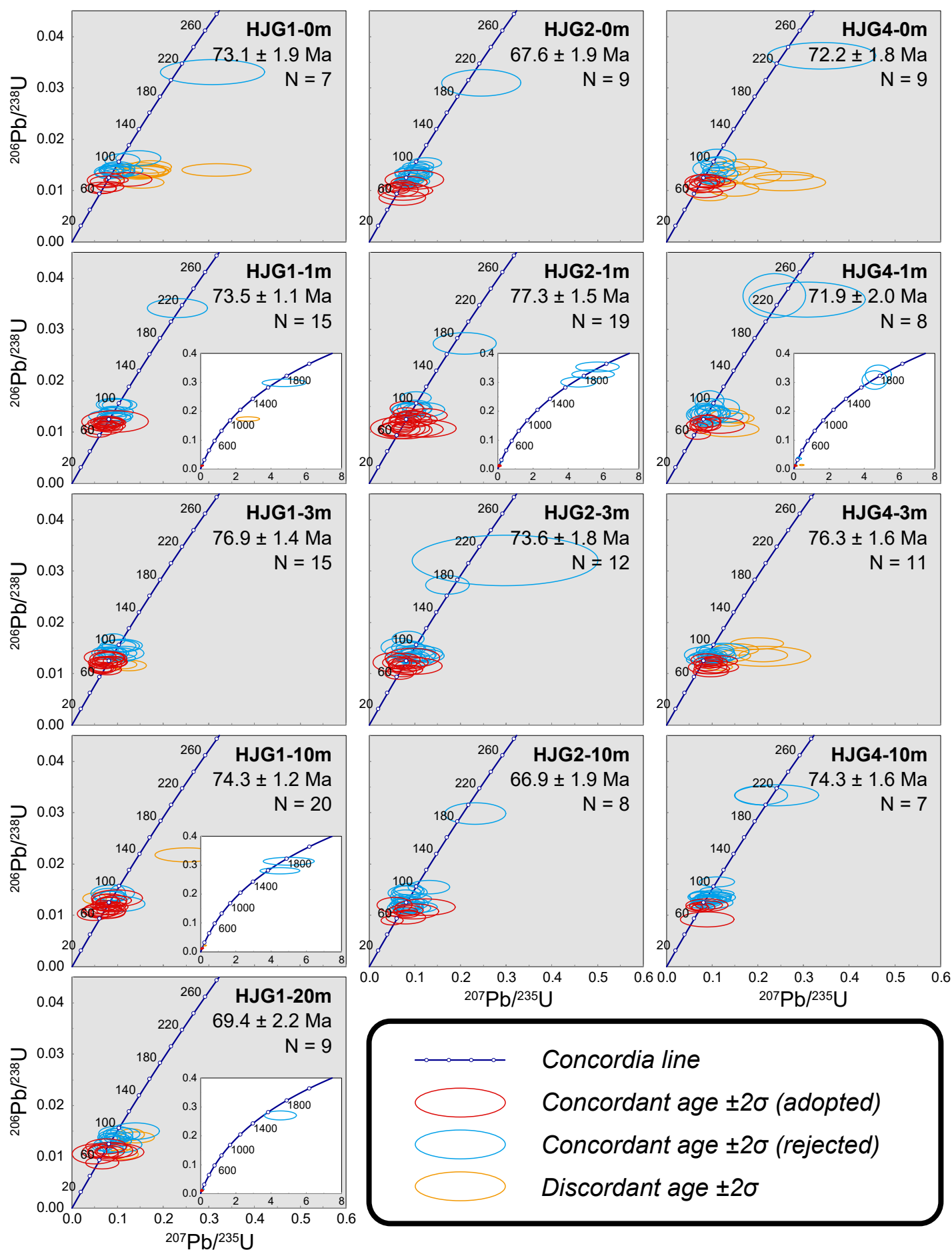
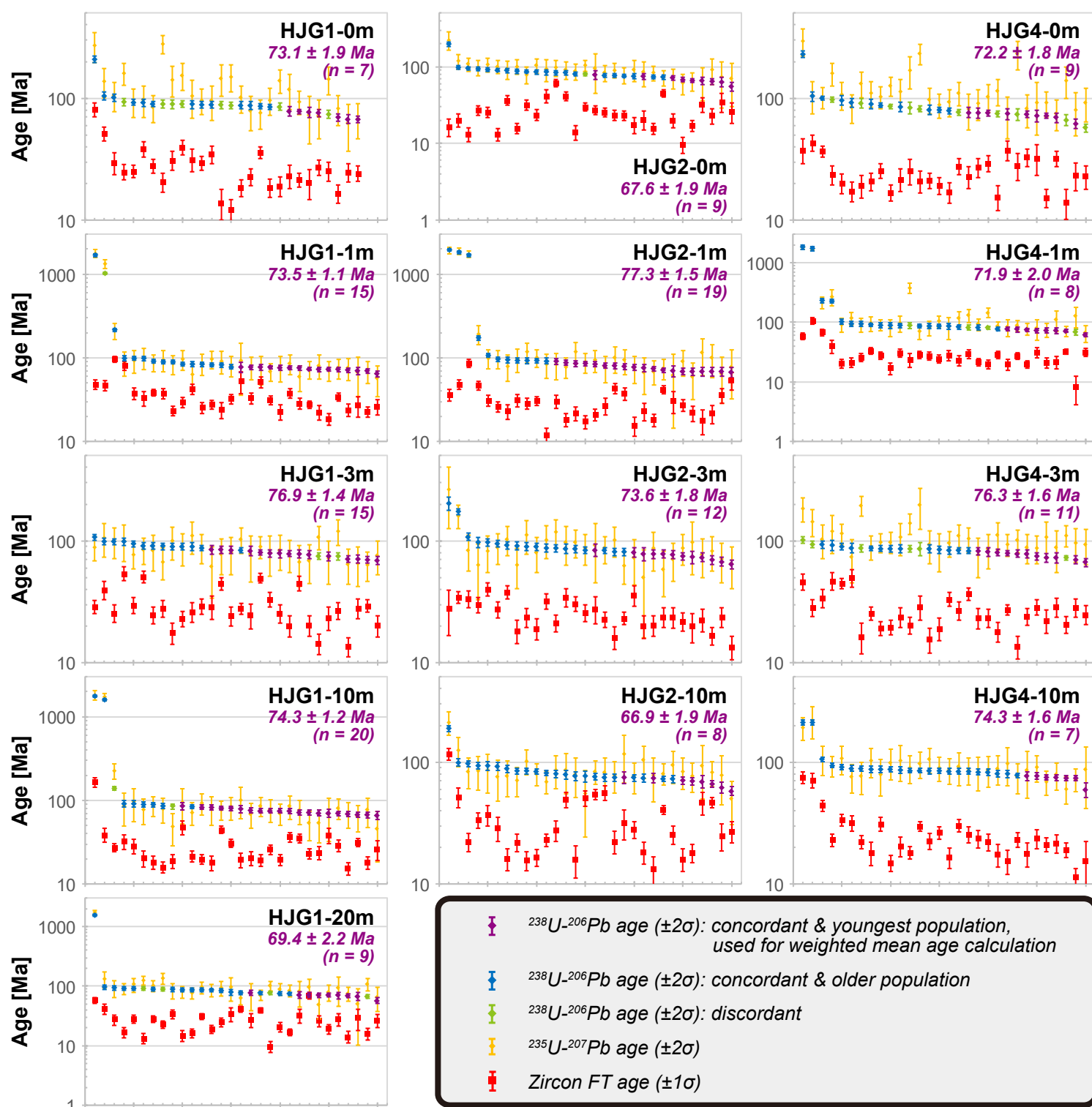
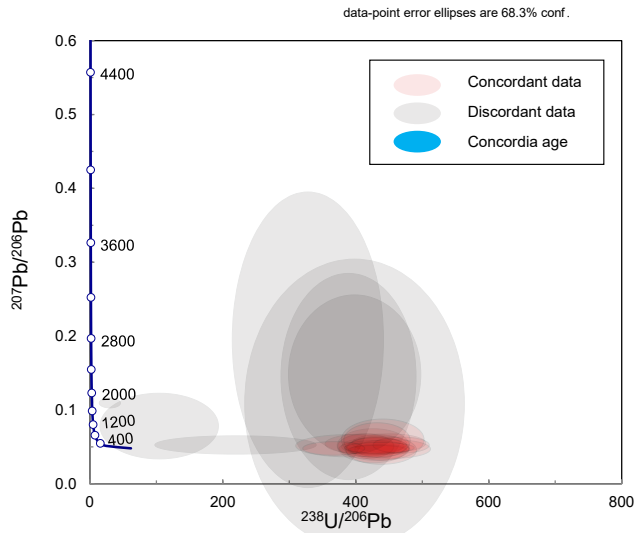


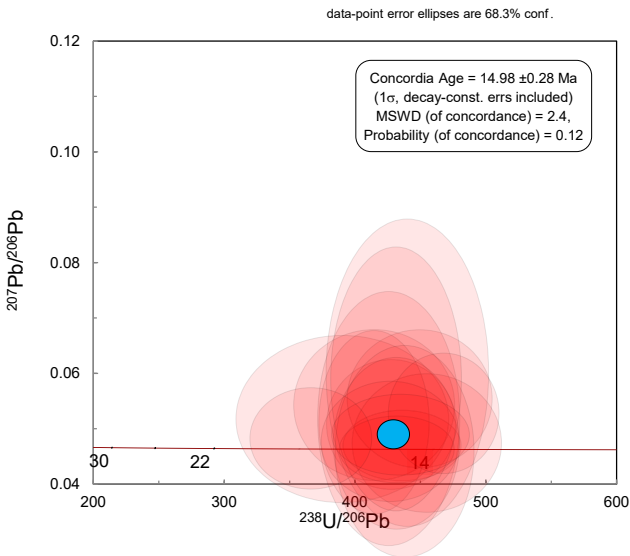
Fig. S2



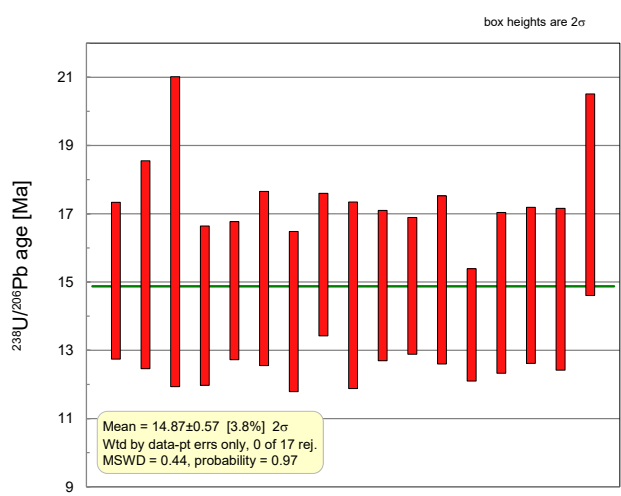
a) HJG3-Upb (all data)



b) HJG3-Upb (concordant data only)



c) HJG3-Upb (weighted mean)



d) OD-3 zircon

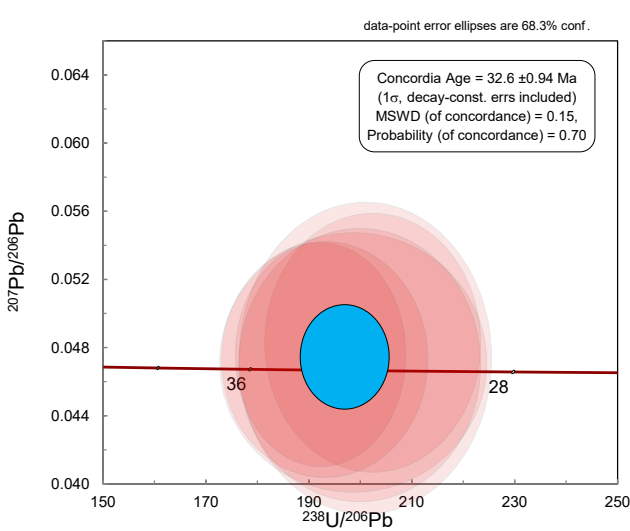


Fig. S4

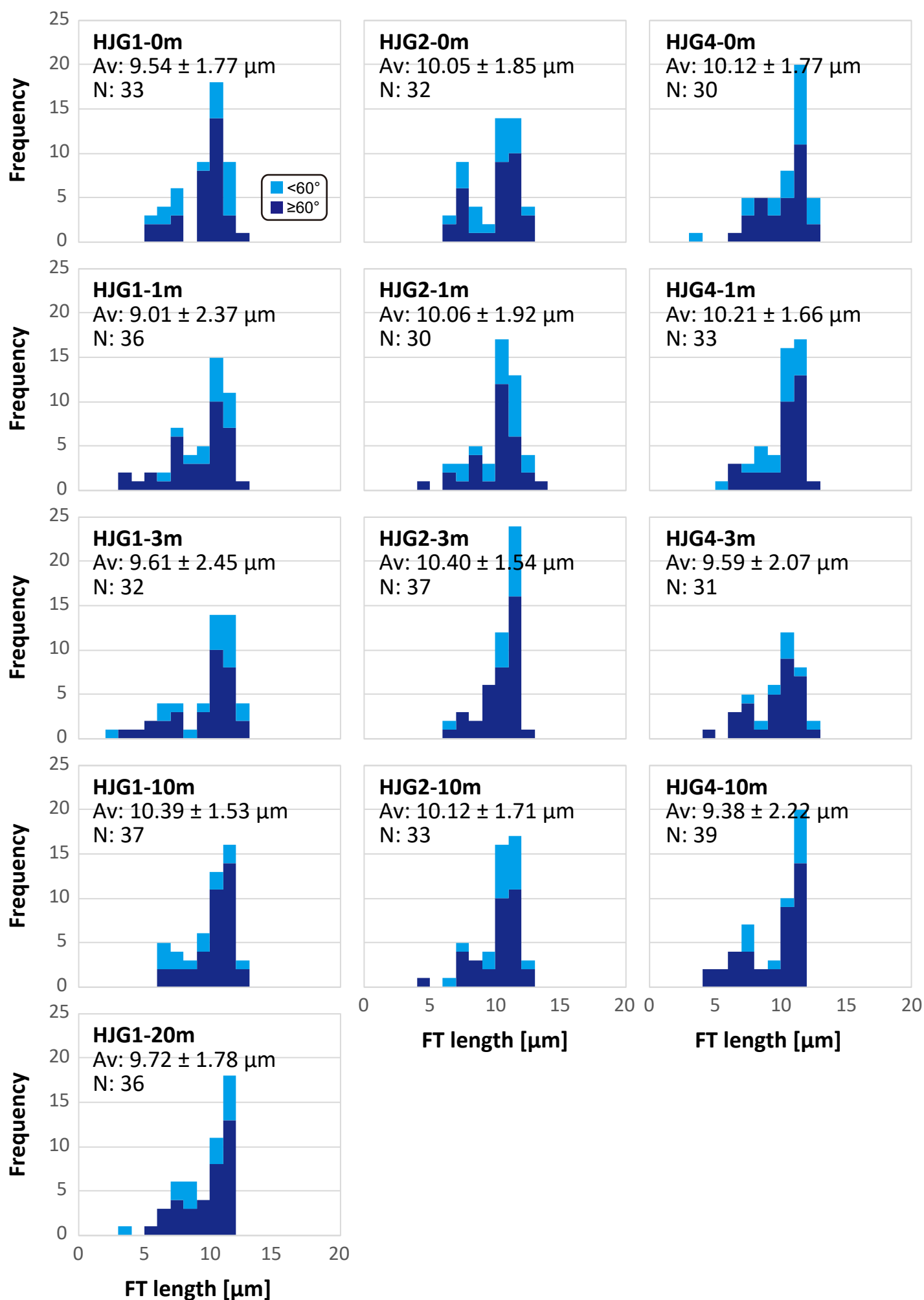


Fig. S5

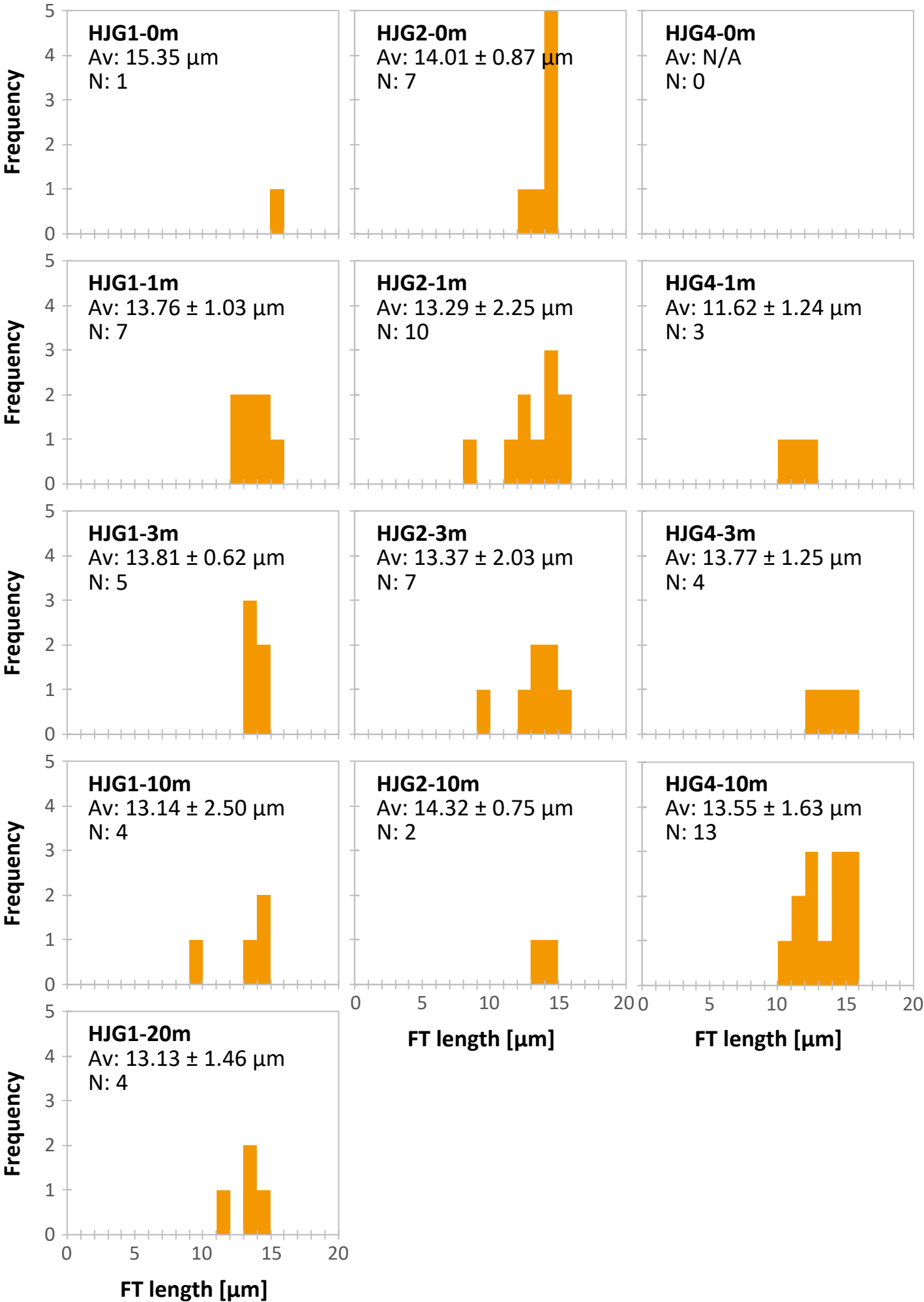


Table S1. Operating parameters for laser ablation inductively coupled plasma mass spectrometer at University of Tokyo.

Laser ablation	
Model	Light Conversion Carbide
Laser type	Femtosecond laser
Pulse width	290 fs
Wave length	257 nm
Energy density	3.7 J/cm ²
Spot size	10 µm
Sampling mode	Multi-spot (galvano mirror system used)
Repetition rate	100 Hz
Laser ablated area	35 µm x 35 µm
Duration of laser ablation	10 s
Carrier gas (He)	0.60 L/min
ICP-MS	
Model	Thermo Fisher Scientific iCAP TM TQ ICP-MS
ICP-MS type	Quadrupole
Operation mode	Single Quadrupole (SQ) mode
Scanning mode	KED mode (He gas was used, 4 mL/min)
RF power	1550 W
Make-up gas (Ar)	0.90 L/min
ThO ⁺ /Th (oxide ratio)	<1%
Data acquisition protocol	Time-resolved analysis
Data acquisition	25 s (15 s gas blank, 10 s ablation)
Monitor isotopes	²⁹ Si (ZFT&U-Pb), ⁴³ Ca (AFT), ²⁰² Hg, ²⁰⁴ Pb, ²⁰⁶ Pb, ²⁰⁷ Pb, ²⁰⁸ Pb, ²³² Th, ²³⁸ U
Dwell time	0.2 s for ²⁰⁶ , ²⁰⁷ Pb, 0.1 s for others
Standards	
Primary standard (U-Pb)	Nancy 91500 ^{*1}
Secondary standard (U-Pb)	OD-3 ^{*2-4} , Plešovice ^{*5} , GJ-1 ^{*6}
Primary standards (ZFT)	Fish Canyon Tuff ^{*7,8} , Tardree Rhyolite ^{*7,8}
Primary standards (AFT)	Fish Canyon Tuff ^{*7,8} , Durango ^{*7,8}

Table S2. Operating parameters for laser ablation inductively coupled plasma mass spectrometer at Tono Geoscience Center.

Laser ablation	
Model	Photon Machines Analyte G2
Laser type	Excimer laser
Pulse width	<5 ns
Wave length	193 nm
Laser power	20%
Energy density	2.0 J/cm ²
Spot size	20 µm
Sampling mode	single spot
Repetition rate	10 Hz
Duration of laser ablation	20 s
Carrier gas (He)	1.0 L/min
ICP-MS	
Model	Thermo Fisher Scientific Neptune- <i>Plus</i>
ICP-MS type	Multiple collector
RF power	1600 W
Make-up gas (Ar)	1.0 L/min
Data acquisition protocol	Time-resolved analysis
Data acquisition	32 s (11 s gas blank, 20 s ablation)
Monitor isotopes	²⁰² Hg (CDD), ²⁰⁴ Pb (CDD), ²⁰⁶ Pb (SEM), ²⁰⁷ Pb (SEM), ²⁰⁸ Pb (SEM), ²³² Th (FC), ²³⁸ U (FC) CDD: Compact Discrete Dynode, SEM: Secondary Electron Multiplier, FC: Faraday Cup
Integration time	0.066 s × 700 ratios
Standards	
Primary standard	Nancy 91500 ^{*1}
Secondary standard	OD-3 ^{*2-4}