GT10-11 - Dissolved and Particulate Th and Pa

Anderson et al (LDEO)

2016-05-16

Notes on DERIVED PARAMETERS

Th_230_D_XS_CONC_BOTTLE:

The dissolved excess Th-230 concentration refers to the measured dissolved Th-230 corrected for a contribution of Th-230 due to the partial dissolution of uranium-bearing minerals, or lithogenics. Thereby the dissolved excess represents solely the fraction of Th-230 produced in the water by decay of dissolved uranium-234. We estimate the lithogenic Th-230 using measuring dissolved Th-232 and a lithogenic Th-230/Th-232 ratio of 4.0e-6 (atom ratio) as determined by Roy-Barman et al. (2002) and a conversion factor to convert picomoles to micro-Becquerels.

Th_230_D_XS_CONC_BOTTLE =
    Th_230_D_CONC_BOTTLE – 4.0e-6 *1.7473e5 * Th_232_D_CONC_BOTTLE

Pa_231_D_XS_CONC_BOTTLE:

The dissolved excess Pa-231 concentration refers to the measured dissolved Pa-231 corrected for a contribution of Pa-231 due to the partial dissolution of uranium-bearing minerals, or lithogenics. Thereby the dissolved excess represents solely the fraction of Pa-231 produced in the water by decay of dissolved uranium-235. We estimate the lithogenic Pa-231 using measuring dissolved Th-232 and a lithogenic Pa-231/Th-232 ratio of 8.8e-8 (atom ratio) which is derived from assuming an average upper continental crustal U/Th ratio (Taylor and McClennan, 1995) and secular equilibrium between Pa-231 and U-235 in the lithogenic material. An additional conversion factor is needed to convert picomoles to micro-Becquerels.

Pa_231_D_XS_CONC_BOTTLE =
    Pa_231_D_CONC_BOTTLE – 8.8e-8 * 4.0370e5 * Th_232_D_CONC_BOTTLE

Th_230_SP_ADS_CONC_PUMP:

The small particulate adsorbed Th-230 concentration refers to the measured small particulate Th-230 corrected for a contribution of Th-230 locked within mineral lattices. For the particulate Th-230 supported by decay of U within mineral lattices, we use measured small particulate Th-232 and a lithogenic Th-230/Th-232 atomic ratio of 4.0e-6. However, because some fraction of the Th-232 is also adsorbed (and not merely found within mineral lattices), we use the dissolved Th-232/Th-230 ratio to estimate what fraction of the small particulate Th-232 is adsorbed and furthermore to calculate the correction for adsorbed Th-230. Conversion factors are also necessary to convert picomoles to micro-Becquerels. When dissolved data do not exist at the same depth of the particulate samples, we linearly interpolated the dissolved data onto the depths of the particulate samples. See Hayes et al. (2015, Marine Chemistry) for more details.

Th_230_SP_ADS_CONC_PUMP =
[Th_230_SP_CONC_PUMP – 4.0e-6*1.7473e5*Th_232_SP_CONC_PUMP] /
[1 – 4.0e-6*1.7473e5* Th_232_D_CONC_BOTTLE /
Th_230_D_CONC_BOTTLE]

Th_230_SP_XS_CONC_PUMP:

The small particulate excess Th-230 refers to the measured small particulate Th-230 corrected for a contribution of Th-230 originating from U-bearing minerals or lithogenic Th-230. Some of this lithogenic Th-230 will be still intact within minerals and some after partial dissolution will have adsorbed to particle surface to contribute in part to the total adsorbed Th-230. Using the measured small particulate Th-232 and a lithogenic Th-230/232 atomic ratio of 4e-6, and not taking into account the fact that some of the measured particulate Th-232 is adsorbed, corrects for all of the lithogenic Th-230 whether it be adsorbed or within intact minerals. This excess Th-230 is what should be used in scavenging or particle flux studies where it is desired to compare particulate Th-230 concentrations to Th-230 production by decay of uranium dissolved in seawater. An additional conversion factor converts picomoles to micro-Becquerels.

Th_230_SP_XS_CONC_PUMP =
Th_230_SP_CONC_PUMP – 4.0e-6 * 1.7473e5 * Th_232_SP_CONC_PUMP

Pa_231_SP_ADS_CONC_PUMP:

The small particulate adsorbed Pa-231 concentration refers to the measured small particulate Pa-231 corrected for a contribution of Pa-231 locked within mineral lattices (as opposed to adsorbed on to particle surfaces). The particulate Pa-231 supported by decay of U within mineral lattices, we use measured small particulate Th-232 and a lithogenic Pa-231/Th-232 atomic ratio of 8.8e-8. However, because some fraction of the Th-232 is also adsorbed (and not merely found within mineral lattices), we use the dissolved and particulate Th-232/Th-230 ratio to estimate what fraction of the small particulate Th-232 is adsorbed and furthermore to calculate the correction for adsorbed Pa-231. Conversion factors are also necessary to convert picomoles to micro-Becquerels. When dissolved data do not exist at the same depth of the particulate samples, we linearly interpolate the dissolved data onto the depths of the particulate samples. See Hayes et al. (2015, Marine Chemistry) for more details.

Pa_231_SP_ADS_CONC_PUMP =
Pa-231_SP_CONC_PUMP –
8.8e-8 * 4.0370e5 * (Th_232_SP_CONC_PUMP – Th_232_D_CONC_BOTTLE*
[(Th_230_SP_CONC_PUMP – 4.0e-6*1.7473e5*Th_232_SP_CONC_PUMP) /
(Th_230_D_CONC_BOTTLE – 4.0e-6*1.7473e5*Th_232_D_CONC_BOTTLE)])

Pa_231_SP_XS_CONC_PUMP:

The small particulate excess Pa-231 refers to the measured small particulate Pa-231 corrected for a contribution of Pa-231 originating from U-bearing minerals or lithogenic Pa-231. Some of this

lithogenic Pa-231 will be still intact within minerals and some after partial dissolution will have adsorbed to particle surface to contribute in part to the total adsorbed Pa-231. Using the measured small particulate Th-232 and a lithogenic Pa-231/Th-232 atomic ratio of 8.8e-8, and not taking into account the fact that some of the measured particulate Th-232 is adsorbed, corrects for all of the lithogenic Pa-231 whether it be adsorbed or within intact minerals. This excess Pa-231 is what should be used in scavenging or particle flux studies where it is desired to compare particulate Pa-231 concentrations to Pa-231 production by decay of uranium dissolved in seawater. An additional conversion factor converts picomoles to micro-Becquerels.

Pa_231_SP_XS_CONC_PUMP =
Pa_231_SP_CONC_PUMP – 8.8e-8 * 4.0370e5 * Th_232_SP_CONC_PUMP

Th_230_LP_ADS_CONC_PUMP:

The large particulate adsorbed Th-230 concentration refers to the measured large particulate Th-230 corrected for a contribution of Th-230 locked within mineral lattices. For the particulate Th-230 supported by decay of U within mineral lattices, we use measured large particulate Th-232 and a lithogenic Th-230/Th-232 atomic ratio of 4.0e-6. However, because some fraction of the Th-232 is also adsorbed (and not merely found within mineral lattices), we use the dissolved Th-232/Th-230 ratio to estimate what fraction of the large particulate Th-232 is adsorbed and furthermore to calculate the correction for adsorbed Th-230. Conversion factors are also necessary to convert picomoles to micro-Becquerels. When dissolved data do not exist at the same depth of the particulate samples, we linearly interpolated the dissolved data onto the depths of the particulate samples. See Hayes et al. (2015, Marine Chemistry) for more details.

Th_230_LP_ADS_CONC_PUMP =
[Th_230_LP_CONC_PUMP – 4.0e-6*1.7473e5*Th_232_LP_CONC_PUMP] /
[1 – 4.0e-6*1.7473e5* Th_232_D_CONC_BOTTLE /
Th_230_D_CONC_BOTTLE]

Th_230_LP_XS_CONC_PUMP:

The large particulate excess Th-230 refers to the measured large particulate Th-230 corrected for a contribution of Th-230 originating from U-bearing minerals or lithogenic Th-230. Some of this lithogenic Th-230 will be still intact within minerals and some after partial dissolution will have adsorbed to particle surface to contribute in part to the total adsorbed Th-230. Using the measured large particulate Th-232 and a lithogenic Th-230/232 atomic ratio of 4e-6, and not taking into account the fact that some of the measured particulate Th-232 is adsorbed, corrects for all of the lithogenic Th-230 whether it be adsorbed or within intact minerals. This excess Th-230 is what should be used in scavenging or particle flux studies where it is desired to compare particulate Th-230 concentrations to Th-230 production by decay of uranium dissolved in seawater. An additional conversion factor converts picomoles to micro-Becquerels.

Th_230_LP_XS_CONC_PUMP =
Th_230_LP_CONC_PUMP – 4.0e-6 * 1.7473e5 * Th_232_LP_CONC_PUMP

Pa_231_LP_ADS_CONC_PUMP:

The large particulate adsorbed Pa-231 concentration refers to the measured large particulate Pa-231 corrected for a contribution of Pa-231 locked within mineral lattices (as opposed to adsorbed on to particle surfaces). The particulate Pa-231 supported by decay of U within mineral lattices, we use measured large particulate Th-232 and a lithogenic Pa-231/Th-232 atomic ratio of 8.8e-8. However, because some fraction of the Th-232 is also adsorbed (and not merely found within mineral lattices), we use the dissolved and particulate Th-232/Th-230 ratio to estimate what fraction of the large particulate Th-232 is adsorbed and furthermore to calculate the correction for adsorbed Pa-231. Conversion factors are also necessary to convert picomoles to micro-Becquerels. When dissolved data do not exist at the same depth of the particulate samples, we linearly interpolate the dissolved data onto the depths of the particulate samples. See Hayes et al. (2015, Marine Chemistry) for more details.

Pa_231_LP_ADS_CONC_PUMP =
Pa-231_LP_CONC_PUMP –
8.8e-8 * 4.0370e5 * (Th_232_LP_CONC_PUMP – Th_232_D_CONC_BOTTLE*
[(Th_230_LP_CONC_PUMP – 4.0e-6*1.7473e5*Th_232_LP_CONC_PUMP) /
(Th_230_D_CONC_BOTTLE – 4.0e-6*1.7473e5*Th_232_D_CONC_BOTTLE)])

Pa_231_LP_XS_CONC_PUMP:

The large particulate excess Pa-231 refers to the measured large particulate Pa-231 corrected for a contribution of Pa-231 originating from U-bearing minerals or lithogenic Pa-231. Some of this lithogenic Pa-231 will be still intact within minerals and some after partial dissolution will have adsorbed to particle surface to contribute in part to the total adsorbed Pa-231. Using the measured large particulate Th-232 and a lithogenic Pa-231/Th-232 atomic ratio of 8.8e-8, and not taking into account the fact that some of the measured particulate Th-232 is adsorbed, corrects for all of the lithogenic Pa-231 whether it be adsorbed or within intact minerals. This excess Pa-231 is what should be used in scavenging or particle flux studies where it is desired to compare particulate Pa-231 concentrations to Pa-231 production by decay of uranium dissolved in seawater. An additional conversion factor converts picomoles to micro-Becquerels.

Pa_231_LP_XS_CONC_PUMP =
Pa_231_LP_CONC_PUMP – 8.8e-8 * 4.0370e5 * Th_232_LP_CONC_PUMP