

# Chapter 4

## Recommended standard operating procedures

Standard operating procedures (SOPs) describe the way specific operations or analytical methods should be carried out. They comprise written instructions which define completely the procedure to be adopted by an analyst to obtain the required result. This Guide contains SOPs that fall under three categories. SOPs with numbers 1–10 are procedures for sampling and analysis. SOPs with numbers 11–20 are procedures related to calibrations. SOPs with numbers 21 and higher are for computations and quality control. These procedures have been in use since the early 1990s and have been revised with accumulated experience and improved technology. These are the recommended standard procedures for those participating in the CLIVAR/CO<sub>2</sub> repeat hydrography program. Each SOP has a revision date and version number that should be cited when referencing a procedure in scientific publications. Procedures for reporting errors are given in Chapter 1.

Many of the SOPs contain example calculations. Our philosophy on the precision given in these is that the answers should be correct whether the later steps are done from the partially rounded intermediate values shown, or all steps are done directly from the input data without rounding. However, there may be a few cases where the final result will be different depending on which of these two approaches is used.

### 1. Procedures for sampling and analysis

- SOP 1 Water sampling for the parameters of the oceanic carbon dioxide system
- SOP 2 Determination of total dissolved inorganic carbon in sea water
- SOP 3a Determination of total alkalinity in sea water using a closed-cell titration
- SOP 3b Determination of total alkalinity in sea water using an open-cell titration
- SOP 4 Determination of  $p(\text{CO}_2)$  in air that is in equilibrium with a discrete sample of sea water
- SOP 5 Determination of  $p(\text{CO}_2)$  in air that is in equilibrium with a continuous stream of sea water

- SOP 6a Determination of the pH of sea water using a glass/reference electrode cell
- SOP 6b Determination of the pH of sea water using the indicator dye *m*-cresol purple
- SOP 7 Determination of dissolved organic carbon and total dissolved nitrogen in sea water

**2. Procedures for calibrations, etc.**

- SOP 11 Gravimetric calibration of the volume of a gas loop using water
- SOP 12 Gravimetric calibration of volume delivered using water
- SOP 13 Gravimetric calibration of volume contained using water
- SOP 14 Procedure for preparing sodium carbonate solutions for the calibration of coulometric  $C_T$  measurements

**3. Procedures for computations, quality control, etc.**

- SOP 21 Applying air buoyancy corrections
- SOP 22 Preparation of control charts
- SOP 23 Statistical techniques used in quality assessment
- SOP 24 Calculation of the fugacity of carbon dioxide in pure carbon dioxide gas or in air