

**Dataset Expocode** 61TG20140510

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**Dataset** **Funding Info:** NIWA Core Funding  
**Initial Submission (yyyymmdd):** 20160113  
**Revised Submission (yyyymmdd):**

**Campaign/Cruise** **Expocode:** 61TG20140510  
**Campaign/Cruise Name:** TAN1405  
**Campaign/Cruise Info:**  
**Platform Type:**  
**CO2 Instrument Type:** Equilibrator-IR or CRDS or GC  
**Survey Type:** Research ship, opportunistic sampling  
**Vessel Name:** RV Tangaroa  
**Vessel Owner:** NIWA  
**Vessel Code:** 61TG

**Coverage** **Start Date (yyyymmdd):** 20140510  
**End Date (yyyymmdd):** 20140520  
**Westernmost Longitude:** 174.7 E  
**Easternmost Longitude:** 179.1 E  
**Northernmost Latitude:** 38.5 S  
**Southernmost Latitude:** 41.7 S  
**Port of Call:** Wellington  
**Port of Call:** Wellington

**Variable** **Name:** Expocode  
**Unit:** none  
**Description:** Expocode where 61 is New Zealand, followed by two letter vessel code, then date voyage left port in format yyyymmdd (UTC)ruise

**Variable** **Name:** Group\_Ship  
**Unit:** none  
**Description:** NIWA- Vessel name

**Variable** **Name:** Cruise ID  
**Unit:** none  
**Description:** NIWA cruise number, in format VVVyyNN where VVV is the vessel name, yy is the year, and NN is the numerical cruise ID

**Variable** **Name:** YD.UTC  
**Unit:** day  
**Description:** Year Day (= Julian day, where 1 = January 1 UTC)

**Variable** **Name:** DATE.UTC\_\_ddmmyyyy  
**Unit:** ddmmyyyy

**Description:** Date in UTC

**Variable**      **Name:** TIME.UTC\_hh:mm:ss  
**Unit:** hh:mm:ss  
**Description:** Time in UTC

**Variable**      **Name:** LAT\_dec\_degree  
**Unit:** decimal degrees  
**Description:** Latitude (positive = North, negative = South)

**Variable**      **Name:** LONG\_dec\_degree  
**Unit:** decimal degrees  
**Description:** Longitude (positive = East, negative = West)

**Variable**      **Name:** xCO2\_EQU\_ppm  
**Unit:** ppm = micromol CO2 per mol air  
**Description:**

**Variable**      **Name:** xCO2\_ATM\_ppm  
**Unit:** ppm = micromol CO2 per mol dry air  
**Description:**

**Variable**      **Name:** xCO2\_ATM\_interpolated\_ppm  
**Unit:** ppm = micromol CO2 per mol dry air  
**Description:** mole fraction of CO2 in the atmosphere (dry) with values linearly interpolated to the times shown

**Variable**      **Name:** PRES\_EQU\_hPa  
**Unit:** hectoPascal  
**Description:** equilibrator head space pressure

**Variable**      **Name:** PRES\_ATM@SSP\_hPa  
**Unit:** hectoPascal  
**Description:** barometric pressure from ship's weather station

**Variable**      **Name:** TEMP\_EQU\_C  
**Unit:** degrees Celsius  
**Description:** Equilibrator water temperature

**Variable**      **Name:** SST\_C  
**Unit:** degrees Celsius  
**Description:** Sea surface temperature from SBE38

**Variable**      **Name:** SAL\_permil  
**Unit:**  
**Description:** Sea-surface-salinity from SBE21

**Variable**      **Name:** fCO2\_SW@SST\_uatm  
**Unit:** microatmosphere  
**Description:** fugacity of CO2 in surface seawater at the in situ temperature

**Variable**      **Name:** fCO2\_ATM\_interpolated\_uatm  
**Unit:** microatmosphere  
**Description:** fugacity of CO2 in the atmosphere, with values linearly interpolated to the times shown

**Variable**      **Name:** dfCO2\_uatm  
**Unit:** microatmospheres  
**Description:** Difference between fCO2SW and fCO2ATM

**Variable**      **Name:** WOCE\_QC\_FLAG

**Unit:** no unit  
**Description:** WOCE quality control flag: 2 = Good 3 = Questionable 4 = Bad (data identified as bad are not reported).

**Variable**

**Name:** WOCE\_QC\_SUBFLAG  
**Unit:** no unit  
**Description:** text describing reason for questionable WOCE FLAG

**Sea Surface Temperature**

**Location:** located in ship-board lab next to pCO<sub>2</sub> system (approx 0 metres depth)  
**Manufacturer:** SeaBird Electronics  
**Model:** SBE21  
**Accuracy:** 0.1 (°C if units not given)  
**Precision:** 0.01 (°C if units not given)  
**Calibration:** Returned to Seabird for calibration every 2 years  
**Comments:** IPTS-68 scale, warming en route from hull intake to SEB21 not accounted for, therefore SST accuracy decreased to 0.1oC and fCO<sub>2</sub> accuracy decreased to 3uatm

**Sea Surface Salinity**

**Location:** located in ship-board lab next to pCO<sub>2</sub> system (approx 0 metres depth)  
**Manufacturer:** SeaBird Electronics  
**Model:** SBE21  
**Accuracy:** 0.05 permille (estimate)  
**Precision:** 0.05 permille (estimate)  
**Calibration:** Returned to Seabird for calibration every 2 years  
**Comments:**

**Atmospheric Pressure**

**Location:** 12.5m  
**Normalized to Sea Level:** yes  
**Manufacturer:** Vaisala DPA21  
**Model:** DPA21  
**Accuracy:** 0.3hPa (hPa if units not given)  
**Precision:** 0.3hPa (hPa if units not given)  
**Calibration:** checked annually by New Zealand Met Service  
**Comments:**

**Atmospheric CO<sub>2</sub>**

**Measured/Frequency:** yes, every 130 minutes (2 hours 15 mins, approximately)  
**Intake Location:** 12.5 metres, away from exhausts at rear of monkey island  
**Drying Method:**  
**Atmospheric CO<sub>2</sub> Accuracy:** XCO<sub>2</sub>: 1 uatm  
**Atmospheric CO<sub>2</sub> Precision:** XCO<sub>2</sub>: 1 uatm

**Aqueous CO<sub>2</sub> Equilibrator Design**

**System Manufacturer:**  
**Intake Depth:** 5.5m  
**Intake Location:** bow intake  
**Equilibration Type:** General Oceanics equilibrator, with water jacket  
**Equilibrator Volume (L):** bow intake, 5.5m depth  
**Headspace Gas Flow Rate (ml/min):** 100 (approx)  
**Equilibrator Water Flow Rate (L/min):** 2.5 (approx)  
**Equilibrator Vented:** Yes  
**Equilibration Comments:**  
**Drying Method:** Permapure Nafion Dryer, > 90 %

**Aqueous CO<sub>2</sub> Sensor Details**

**Measurement Method:** IR  
**Method details:** infra red gas analysis  
**Manufacturer:** LI-COR  
**Model:** LI-7000

**Measured CO2 Values:** xCO2(dry)  
**Measurement Frequency:** Every 58 sec, except during calibration routines  
**Aqueous CO2 Accuracy:** fCO2: 3 uatm  
**Aqueous CO2 Precision:** fCO2: 3 uatm  
**Sensor Calibrations:** Calibrations of CO2 sensor using four standards approx every 2.25 hours. Standards calibrated on WMO-X2007 mole fraction scale for CO2-in-air at NIWA Wellington. Standard XCO2 values: 0.00, 334.15, 394.59, 416.31 ppm. Uncertainty 0.05ppm  
**Calibration of Calibration Gases:** CO2-in-air prepared and calibrated at NIWA, Wellington, against the WMO-X2007 mole fraction scale  
**Number Non-Zero Gas Standards:** 3  
**Calibration Gases:**  
0.00ppm, provided by BOC New Zealand, Zero gas run every 2.25 hours  
334.15 ppm, prepared and calibrated by NIWA, Wellington, run every 2.25 hours  
394.59 ppm, prepared and calibrated by NIWA, Wellington, run every 2.25 hours  
416.31 ppm, prepared and calibrated by NIWA, Wellington, run every 2.25 hours

**Comparison to Other CO2 Analyses:**

**Comments:**

**Method Reference:**

Dickson, A.G., C. Sabine and J. R. Christian (2007) Guide to best practices for Ocean CO2 measurements. PICES Special Publ. 3, 191 pp.  
Pierrot, D., C. Neill, K. Sullivan, R. Castle, R. Wanninkhof, H. Lüger, T. Johannessen, A. Olsen, R. A. Feely, C. E. Cosca (2009) Recommendations for Autonomous Underway pCO2 Measuring Systems and Data Reduction Routines, Deep-Sea Research II, doi:10.1016/j.dsr2.2008.12.005

**Equilibrator  
Temperature Sensor**

**Location:** equilibrator temperature measured by Hart probe placed in equilibrator  
**Manufacturer:** Fluke (Hart Scientific)  
**Model:** 1523 (s/n 2120040) paired with probe 5610-9-P (s/n B272601)  
**Accuracy:** 0.009 (°C if units not given)  
**Precision:** 0.005 (°C if units not given)  
**Calibration:** Factory calibrated 2012  
**Comments:**

**Equilibrator  
Pressure Sensor**

**Location:** directly above the equilibrator  
**Manufacturer:** Setra differential pressure transducer,  
**Model:** Setra model 239  
**Accuracy:** 0.05 hPa (Estimate) (hPa if units not given)  
**Precision:** 0.05 hPa (Estimate) (hPa if units not given)  
**Calibration:** use initial calibration, not checked  
**Comments:**

**Additional  
Information**

**Suggested QC flag from Data Provider:** NB  
**Additional Comments:** Institutional Reference: <https://www.niwa.co.nz/atmosphere/programme-overview/oceanic-control-of-atmospheric-composition>  
Instrumentation: Andrew Marriner (NIWA), John McGregor (NIWA) Data Quality Control: Andrew Marriner (NIWA), Murray Smith (NIWA) Thanks to Fiona Elliot and Mark Gall for the maintenance of the underway system.  
**Citation for this Dataset:**  
Please follow the SOCAT data use policy  
**Other References for this Dataset:**