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Jeremy Hall, Cemil Gurbuz, Stelios Nicolaides,  
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Scientific Technical Report STR15/07 - Data  
GIPP Experiment- and Data Archive

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# Data of the amphibious wide-angle seismic experiment in south Turkey, Cyprus and south of Cyprus (Eratosthenes Seamount) in the framework of the CyprusArc project (March 2010) - Report

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## Abstract

*Raw-, SEG-Y and other supplementary data of the amphibious wide-angle seismic experiment carried out in South Turkey, Cyprus and south of Cyprus are presented. The aim of this project was to reveal the crustal structure of the Anatolian plateau, Cyprus and the Eratosthenes Seamount (ESM), south of Cyprus. Simultaneous data acquisition offshore with ocean bottom seismometers and airguns and onshore with seismic land stations and two land shots in South Turkey lead to a 650 km long amphibian seismic profile.*

**Coordinates:** 35°03'N/33°16'E (Cyprus)

**Supplementary data:** <http://dx.doi.org/10.5880/GIPP.201001.1>

**Keywords:** Wide-angle seismic, crustal structure, eastern Mediterranean, Cyprus, south Turkey, Eratosthenes Seamount

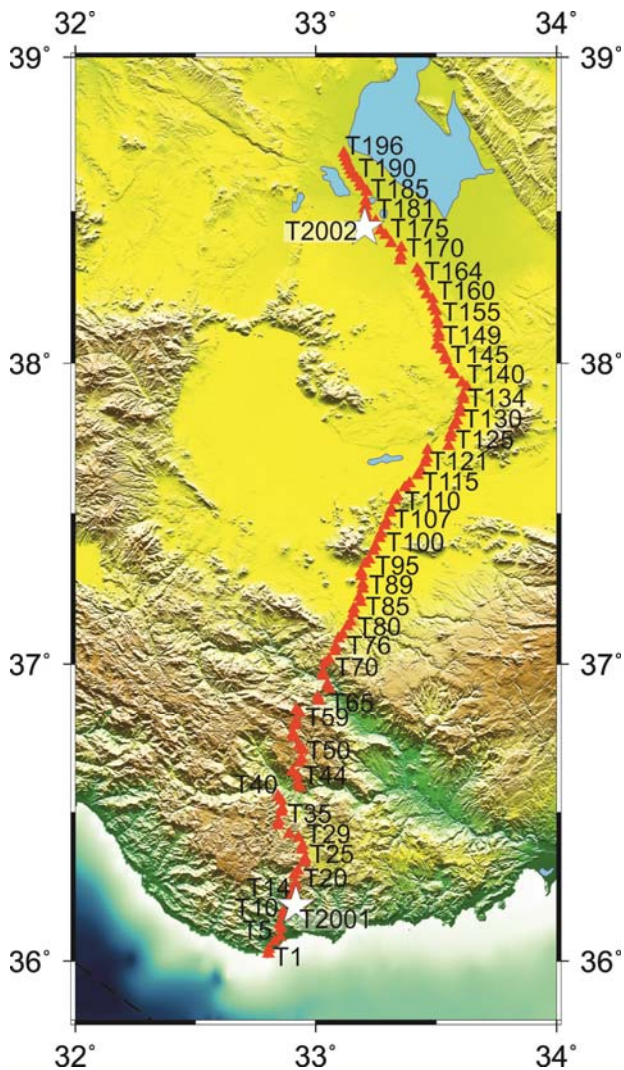
## 1. Introduction

The wide-angle seismic investigation presented here, took place within the CoCoCo (**C**ontinent-**C**ontinent **C**ollision) project which was launched in 2010 / 2011. This project strives for a quantitative understanding of earth processes related to incipient continent-continent collision and to reveal its impact on the crystalline basement and sedimentary cover, as exemplified by Cyprus and the Eratosthenes Seamount (ESM) in the eastern Mediterranean (Ben-Avraham et al., 2002; Netzeband et al., 2006; Robertson, 1998b). As the ESM is considered as a continental fragment of the African plate (Ben-Avraham et al., 2002; Netzeband et al., 2006; Robertson, 1998b), this tectonic setting provides the unique opportunity to investigate the transition from a subduction regime to continent-continent collision. The 3D geometry of the under-thrusted crustal block of the seamount will be examined for the first time by the integrated interpretation of seismic refraction, gravity, magnetic, magnetotelluric and multi-channel seismic data within the CoCoCo Project.

## 2. Data Acquisition

### 2.1 Experiment design and schedule

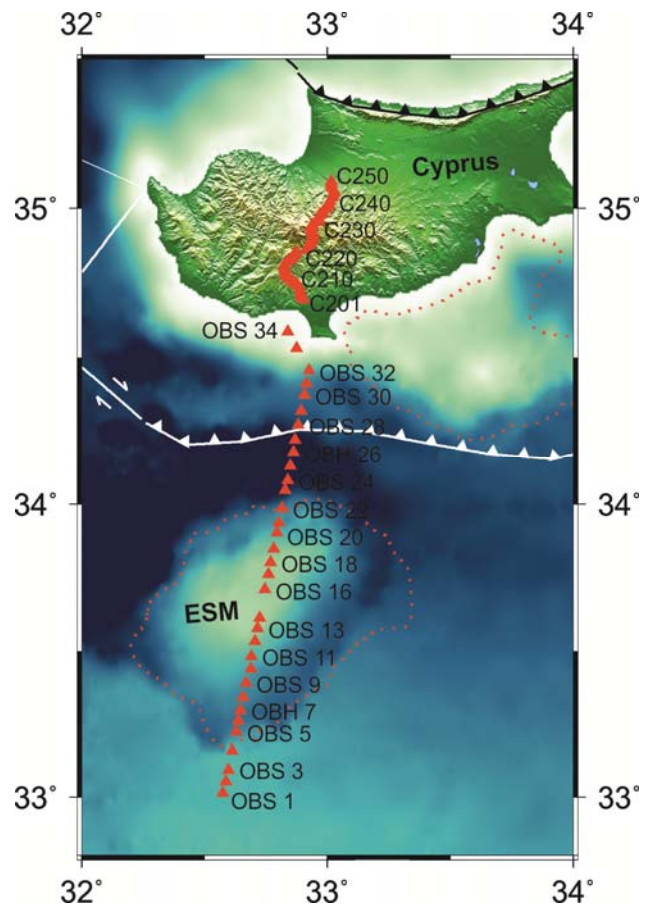
In the framework of a controlled source experiment a 650 km long amphibious seismic profile was completed extending from the Tuz Gölü basin in the north to the Eratosthenes Seamount (ESM) in the south, crossing Cyprus. The profile consists of an onshore part (Cyprus, South Turkey, Fig. 2.1) and an offshore part (South of Cyprus, ESM, Fig. 2.2). The offshore and the onshore surveys were performed at the same time to achieve an amphibian connection between both parts. The airgun shots of the offshore survey were also recorded by the stations onshore Cyprus.



**Figure 2.1: Station map of the Turkish onshore part. Turkish stations (red triangles, T1 - T196) and both land shots (white stars, T2001 and T2002) are labeled**

#### Onshore

During the period from 23.03.2010 to 06.04.2010 246 land stations were deployed. 50 stations (station numbers C201 to C250) were deployed on Cyprus and 196 in South Turkey (T1 - T185, T187-T196 and T256 which has the same location as T56). All station locations, including elevations and sampling rates are shown in </info/Stationlist.pdf>.

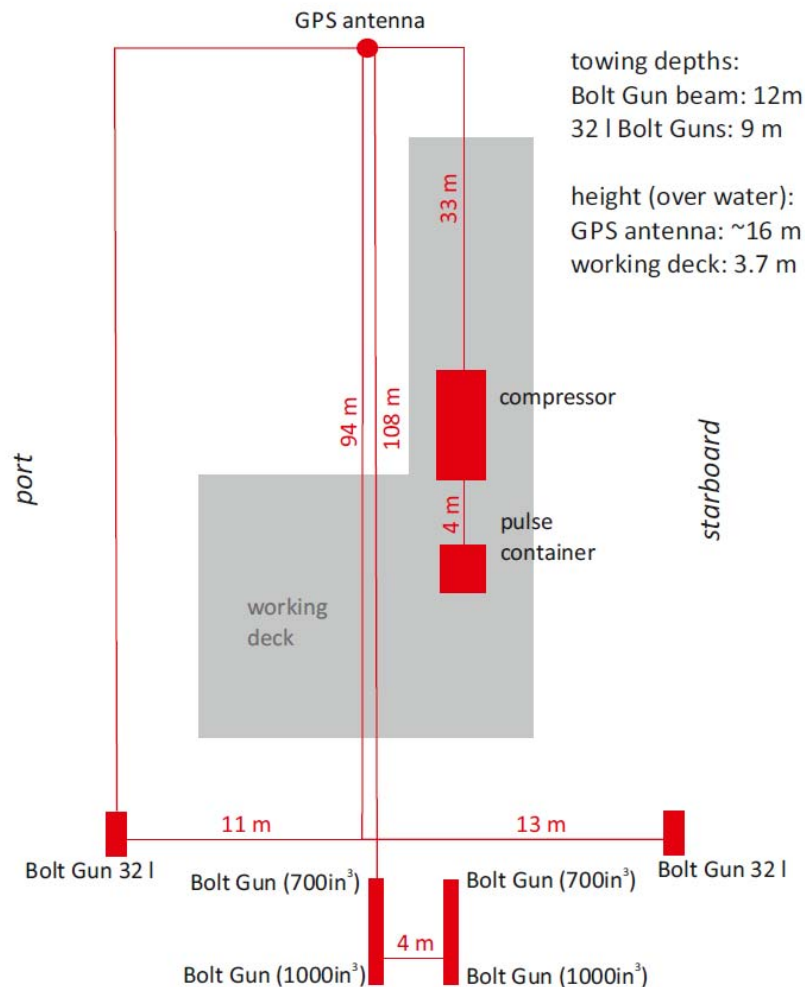


**Figure 2.2: Station map of the area of Cyprus (onshore) and south of Cyprus (offshore)**

The seismic sources on land were two land shots each of 1125 kg seismic dynamite (locations shown as white stars in Fig. 2.1, T2001: southern land shot and T2002: northern land shot). Each shotpoint consisted of two boreholes with a depth of ~ 52 m and a diameter of 32 cm.

### Offshore

The offshore wide-angle data were acquired with the research vessel Maria S. Merian during the cruise MSM14 leg 3 during the period from 12.03.2010 to 05.04.2010. Besides shallow reflection seismic, magnetic, magnetotelluric, gravity and hydroacoustic measurements this survey involves four wide-angle reflection/refraction profiles (WARRPs). The profile WARRP 27 is the offshore part of the amphibian profile presented in this study.



**Figure 2.3: Schematic sketch showing the survey geometry for wide-angle profile WARRP27 (after Hübscher, 2012)**

6 BOLT airguns (2 x 700 in<sup>3</sup>, 2x 1000 in<sup>3</sup> and 2 x 1900 in<sup>3</sup>) with a total volume of 120 liters were used as the seismic source. The survey geometry set-up is shown in Fig. 2.3. The airguns were shot directly along the profile where the stations had been previously deployed. Shots were fired at a pressure of 120 bar with a shot interval of 60 s, resulting in a shot distance of approximately 120 m at a ship's speed of 4 kn over ground. Synchronization and triggering were done by the SureShot trigger system (Hübscher, 2012).

## 2.2 Geometry/Location

The detailed station list with the exact locations of all ocean bottom seismometers / hydrophones, all Turkish and Cyprus land stations and both land shots is given in */info/Stationlist.pdf*.

## 2.3 Instrumentation

### Onshore

For the data recording onshore on Turkey and Cyprus 102 stations were equipped with an Earth Data Logger (EDL) and a 3 channel Mark 1 Hz seismometer or 3 channel 4.5 Hz geophone. 84 stations consisted of a DSS Cube data logger and a 1 channel 4.5 Hz Geophone. This instrumentation was provided by the Geophysical Instrument Pool Potsdam, GIPP. 60 stations were REFTEK Texan instruments from Bogazici University in Istanbul (shown by "tXXXX" as station type in */info/Stationlist.pdf*, data from Turkish stations are not in this archive.). The exact time for the recordings is transmitted by an internal GPS for the Cube and EDL stations. Due to the fact that the REFTEK Texans have no internal GPS, they are synchronized before and after the deployment to GPS and then a linear drift correction is applied. Due to political reasons it was not possible to deploy stations in the Turkish part of Cyprus (northern part). The average station spacing in Turkey was about 1.25 km and about 0.9 km in Cyprus. The EDL and Cube stations recorded the data with a sampling rate of 100 sps. The Texan instruments recorded the data at 125 sps.

### Offshore

For data recording 34 ocean bottom seismometers (OBS) and hydrophones (OBH) were deployed. 19 of these were Canadian ocean bottom seismometers from Dalhousie University. The sensors comprise a 3-component 4.5 Hz geophone and an OAS E-2SD hydrophone. The other 15 stations (10 OBS and 5 OBH) were German instruments from the University of Hamburg consisting of LE-1D/V seismometers, HTI-04-PCA/ULF hydrophones and a Geolon MLS data logger. Accurate time is ensured by synchronizing the internal clock with the GPS time signal before deploying and after recovery and an elimination of the linear time shift if necessary. The OBS stations recorded the data with a sampling rate of 200 or 250 sps and the OBH stations with 50 sps.

## 2.4 Acquisition parameters

**Table 2.1: Summary of the wide-angle survey (offshore part)**

source	1520 airgun shots (Bolt airguns, total volume 120 l)
receiver	34 ocean bottom seismometers and hydrophones
Instrumentation	3-component 4.5 Hz geophone, LE-1D/V seismometer and hydrophones
sampling rate	OBH = 50 sps , OBS = 200 or 250 sps
shot spacing	120 m (every 60 seconds)
receiver spacing	~ 5 km

**Table 2.2: Summary of the wide angle survey (onshore part)**

source	2 land shots (seismic dynamite, each 1125 kg)
receiver	246 land stations (196 in S. Turkey and 50 in Cyprus)
instrumentation	1 ch 4.5 Hz geophone, 3 ch 1 Hz Mark seismometer or 3 ch 4.5 Hz geophone, Cube, EDL and REFTEK Texan as data logger
sampling rate	100 or 125 sps
receiver spacing	~ 1.25 km (Turkey) and ~ 0.9 km (Cyprus)

### 3. Data Processing

The data processing was performed with Promax 5000 at the GFZ in Potsdam. The archived processed SEGY data include the following processing steps:

- bandpass filtering (Butterworth, zero phase, 3-20-9-20 & 3-20-20-20)
- geometry editing (corrected location of receiver, added water depth)
- traveltimes were reduced by 8km/s
- automatic gain correction (5000ms operator length)

### 4. Data Description

Each SEGY file from the ocean bottom instruments (OBS\* & OBH\*) and from the Cyprus stations (C\*) contains the recordings of all airgun shots fired along the offshore part south of Cyprus (common receiver gather). This transect has a length of about 180 km.

The two SEGY files from the Turkish part (t\*) contain the recordings of the land shots (T2001 = southern landshot, T2002 = northern landshot) from all receivers located in Turkey and Cyprus (common shot gather).

All SEGY files are archived with two different filters. A bandpass of 3 to 9 Hz is used for analyzing the main frequency content of the airgun shots / land shots. For a wider frequency range a bandpass of 3 to 20 Hz is also applied and archived.

#### 4.1 File format (s)

SEGY Format specifications and processing (segy/\*.sgy):

##### **Offshore (OBS\* & OBH\*):**

IBM Real, Linear moveout correction (reduced traveltimes by 8km/s, 1000 ms additional bulk shift), Butterworth bandpass filter 3-9 Hz, Automatic Gain correction (5000ms operator length), added water depths (2000ms bulk shift)

##### **Onshore Cyprus (C\*):**

IBM Real, Linear moveout correction (reduced traveltimes by 8km/s, 1000 ms additional bulk shift), Butterworth bandpass filter 3-9 Hz, Automatic Gain correction (5000ms operator length), added water depths (2000ms bulk shift)

##### **Onshore Turkey (T\*):**

IBM Real, Linear moveout correction (reduced traveltimes by 8km/s, 1000 ms additional bulk shift), Butterworth bandpass filter 3-9 Hz, Automatic Gain correction (5000ms operator length), traveltimes are shifted with 15,542 s



## 4.2 Data content and structure:

**Table 4.1: content of folder "201001":**

File name	Description / comments
Raw data sorted by station type	
raw/edl/*	Raw data (unprocessed) recorded by the Earth Data loggers (EDL)
raw /obs-hh1/*	Raw data (unprocessed) recorded by German ocean bottom instruments
raw /obs-ca/*	Raw data (unprocessed) recorded by Canadian ocean bottom instruments
raw /cube/*	Raw data (unprocessed) recorded by CUBES
raw /obs-hh2/*	Raw data (unprocessed) recorded by German ocean bottom instruments
Segy files sorted by station number	
segy/*BP3-9*.sgy	Segy files sorted by station type and station number (obs/obh* = ocean bottom station, C* = station from Cyprus, t* = land shots from Turkey), band pass filtered from 3 to 9 Hz
segy/*BP3-20*.sgy	Segy files sorted by station type and station number (obs/obh* = ocean bottom station, C* = station from Cyprus, t* = land shots from Turkey), band pass filtered from 3 to 20 Hz
INFO data	
info/segp1_promax5000_new.sou	<b>Shot list for all airgun shots</b> south of Cyprus with shot number, UTM X, UTM Y, Depth (m), Depth (m)
info/Landstats_list.txt	<b>Station list for all land stations</b> in Turkey and Cyprus with „R“, station number, UTM X, UTM Y, Elevation (m), Elevation (m)
info/Landshot_list.tab	<b>Shot list of all (2) land shots</b> on Turkey with „S“, shot number, UTM X, UTM Y, Elevation (m), Elevation (m)
info/Stationlist.pdf	Detailed station list with the exact locations of all Turkish and Cyprus stations and of both land shots
info/Stationsmap+experimentbilder.jpg	(a) Map view of stations (red triangles) and land shots (white stars), where the dashed black line is the defined profile line and (b) pictures of field work.

## 5. Data Quality/Accuracy

Generally, the signal to noise ratio and the GPS timing of the data is good. At many stations a clear first onset is observable along the whole profile (e.g. OBS 02).

For the offshore stations and the onshore REFTEK Texan instruments the accurate time is ensured by synchronizing the internal clock with the GPS time signal before deploying and after recovery and an elimination of the linear time shift if necessary. For the other onshore stations the exact time for the recordings is transmitted by an internal GPS for the Cube and EDL instruments.

Stations C221, C222, C241 and OBS 15 recorded no or very noisy data. These stations were rejected from further processing and archiving.

## 6. Data Availability/Access

The data are archived at the *GIPP Experiment and Data Archive* where they are freely available for further use. When using the data, please give reference to this Scientific Technical Report STR – Data and to the respective data publication of Feld et al. (2015). Recommended citation for the data report is:

Feld, C., Mechie, J., Hübscher, C., Gurbuz, C., Nicolaidis, S., Hall, J., Loudon, K. (2015) Data of the amphibious wide-angle seismic experiment in south Turkey, Cyprus and south of Cyprus (Eratosthenes Seamount) in the framework of the CyprusArc project (March 2010). Scientific Technical Report STR - Data 15/07 (GIPP Experiment and Data Archive), <http://dx.doi.org/10.2312/GFZ.b103-15075>; Potsdam.

The DOI of the supplementary dataset is: <http://dx.doi.org/10.5580/GIPP.201001.1>

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