S5   High-resolution multi-disciplinary monitoring of active fault test-site areas in Italy

List of participants (Research Units)

1. **RU1** – Istituto Nazionale Geofisica e Vulcanologia
Responsible: Lauro Chiaraluce (INGV-CNT)

2. **RU2** – University of Perugia
Responsible: Massimiliano Rinaldo Barchi (Department of Earth Science, Univ. Perugia)

3. **RU3** - Istituto Nazionale Geofisica e Vulcanologia
Responsible: Lucia Margheriti (INGV-CNT); Giuseppe D'Anna (INGV-CNT)

4. **RU4** – University of Messina
Responsible: Giancarlo Neri (Department of Department of Earth Science, Univ. Messina)

5. **RU5** - Istituto Nazionale Geofisica e Vulcanologia
Responsible: Antonio Avallone (INGV – CNT)

6. **RU6** – University of Naples "Federico II"
Responsible: Aldo Zollo (Department of Physical Sciences, Univ. Naples "Federico II")

General Objective

S5 project is aimed at supporting the ongoing research on selected Italian test sites where advanced monitoring geophysical networks are available or under construction.

The main general objective of the project is to improve the understanding of earthquake generation processes in Italy and to define the seismic rates in the three selected test sites by developing and applying innovative methodologies to data-banks gathered by multi-disciplinary geophysical networks.
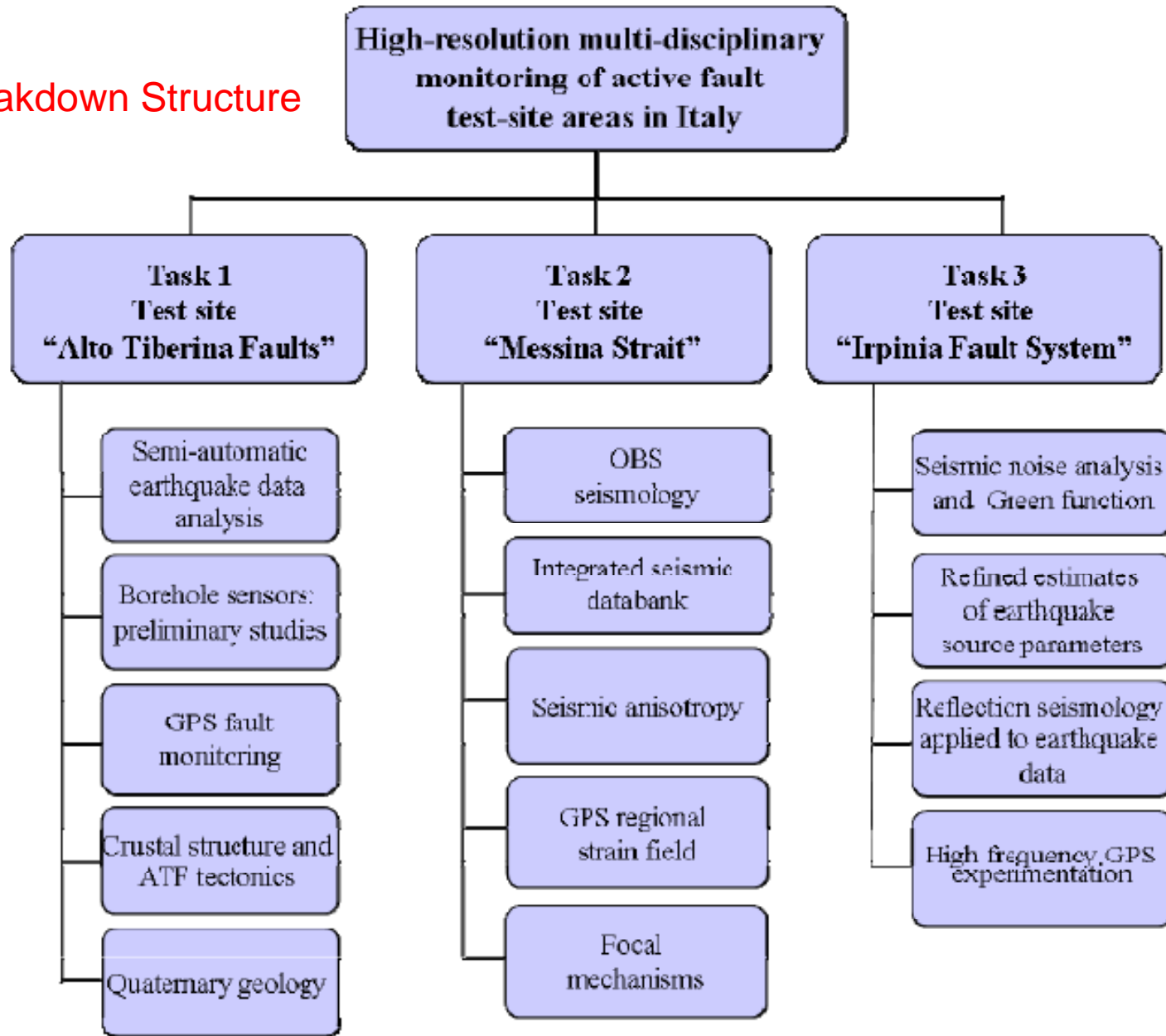
The three selected test sites are:

• The Alto Tiberina Fault (ATF) test site, located inside the Northern Apennines mountain;

• The Messina Strait test site, which include the southernmost portion of Italy and N-E of Sicily: Calabro-Peloritani arc

• The Irpinia fault system test site, located along the Southern Apenninic mountain belt.

Specific Goals

- To promote an innovative and multidisciplinary research activity on the fault systems monitored by three advanced seismological and geodetic networks in sites where further research infrastructures will be potentially developed. The project integrate the ad-hoc monitoring networks of the three sites with existing permanent networks in the regions (INGV seismic and geodedic networks and acceleromentic data archived by S4).

- To implement analysis and modeling methodologies to be applied to geodetic and seismological data acquired (in real-time and off-line) to gain a detailed picture of seismogenic sources and of the crust structure at the three test sites. The project S1 will benefit of the improvements gained at the three test site.

- To improve the knowledge of the active faults seismogenetic potential thanks to the high resolution networks available in the test sites.

- To develop and apply new techniques (potentially real time) to gain information on the space-temporal evolution of the fractures field in the monitored areas trough detailed earthquake location, magnitude estimation and seismic anisotropy monitoring for early warning and shake-maps applications (in close cooperation with S3).

Project
Work Breakdown Structure

Principal investigators and Research topics

Task	WorkPackage PI	Research topic
Task 1. Test site "Alto-Tiberina Fault" Chiaraluce,L., CNT-INGV chiaraluce@ingv.it A high density network including borehole observations for the understanding of physical processes which govern the earthquake generation on low-angle dipping normal faults.	**WP1.1** Di Stefano, CNT-INGV raffaele.distefano@ingv.it	Automated seismic data analysis
	WP1. 2 Improta, RM1-INGV improta@ingv.it	Imaging the shallower portion of the Tiber basin to optimize the installation of borehole seismic sensors
	WP1.3 D'Agostino, RM1-INGV dagostin@ingv.it	Velocity and strain rate fields across the fault from integration of regional GPS networks.
	WP1.4 Mirabella Universita' di Perugia mirabell@unipg.it	Upper crustal structure and tectonic evolution of ATF
	WP1.5 Barchi Universita' di Perugia mbarchi@unipg.it	Quaternary tectonics of the ATF region
Task 2. Test site "Messina Strait" Margheriti L., CNT-INGV margheriti@ingv.it An on-land, off-shore integrated seismic network for monitoring the region struck by the M 7, 1908 Messina earthquake and understanding the relationship between present stress regime and earthquake activity.	**WP2.1** D'Anna e Mangano CNT-INGV danna@ingv.it;mangano@ingv.it	Sea Bottom Seismograph installation and data transmission testing through acoustic link
	WP2.2 Moretti , CNT-INGV moretti@ingv.it	Integrated on-land and off-shore seismic data bank and refined earthquake location
	WP2.3 Piccinini RM1- INGV piccinini@ingv.it	Seismic anisotropy analysis aimed at defining the present crustal deformation regime
	WP2.4 Mattia, CT-INGV mattia@ct.ingv.it	Strain field of Calabria and Peloritano regions from GPS data acquisition and modeling
	WP2.5 Neri, Univ. Messina geoforum@unime.it	Fault mechanisms and stress regime orientations in the Messina strait.
Task 3. Test site "Irpinia Fault System" Zollo A., UniNa aldo.zollo@unina.it An advanced, real-time, seismic monitoring infrastructure for the detailed imaging and characterization of a complex normal fault system in southern Apennines.	**WP3.1:** Festa, UniNA festa@na.infn.it	Seismic noise analysis and Green Functions
	WP3.2: Satriano, UniNa-AMRA scarl satriano@na.infn.it	Refined estimates of micro-earthquake source parameters
	WP3.3 Maercklin, UniNA maercklin@na.infn.it	Reflection/transmission tomography from micro-earthquake data
	WP3.4: Avallone CNT-INGV avallone@ingv.it	High rate GPS for the monitoring of active seismic fault systems in southern Apennines

Project Management Structure

Coordinators:

Lucia Margheriti, INGV-CNT

Aldo Zollo, Dip. Scienze Fisiche - Università di Napoli "Federico II"

Task responsibles:

Task 1 – Lauro Chiaraluce, CNT-INGV

Task 2 – Lucia Margheriti, CNT-INGV

Task 3 – Aldo Zollo, DSF-UNINA

- Close interaction between Task coordinators (i.e. test site responsibles) and WP responsibles
- Promote frequent task (test-site) meetings for coordinating the planned research activities and surveying of deliverable achievement
- Reporting activity

Project Meetings

Meeting Scheduling

• About every 4 months Task Leader meeting

• About every 6 months: Coordinators will meet all Research Units Responsibles involved in the Project

(powerpoint presentation will be prepared and circulate periodically)

• Task Leaders will arrange internal meeting with WP responsibles when they consider necessary to do

Policies about diffusion of results

Inform coordinators about workshop partecipation, articles submission etc… (send title, authorship, abstract,…) → web site, reports

Every publication will have to feature a statement regarding the Financial Institution of research activity (to be defined)

A project web site and a shring data server will be realized and maintained for the entire duration of the project (CNT-INGV??)

Deliverables – Test site ATF

D1	Standard modular automatic procedures for the management and analysis of a continuous seismic data stream	1	1.1
D2	HR and VHR stack sections and Vp images of the basin (500-1000 m deep) and of the shallow fault zones (100-deep) belonging to western splays of the ATF.	1	1.2
D3	Definition of an optimal site for a 200 m deep drilling in the basin to install borehole seismometers	1	1.2
D4	Time series of GPS stations at ATF test site in the ITRF2005 reference frame. GPS velocity field in the ITRF2005 and Eurasian reference frames.	1	1.3
D5	Map of strain rate and geodetic moment rate at ATF test site	1	1.3
D6	Balanced geological sections, derived from depth converted seismic profiles at ATF test site	1	1.4
D7	Isobath maps of the top basement reflector; isobath map of the ATF	1	1.4
D8	Geological and geomorphological map of the from to Città di Castello	1	1.5

Deliverables – Test site Messina Strait

D9	Test of marine seismic deployment and integration of OBS data with on land data.	2	2.1
D10	Test of the acoustic link to get quasi-real time data from OBS stations	2	2.1
D11	Integrated data bank of continuous recordings for the period October 2007-October 2009 at the strait test-site	2	2.2
D12	Refined earthquakes locations in the Tyrrhenian and Ionian regions around to define seismogenic structures	2	2.2
D13	An automatic code for the evaluation of shear wave splitting parameters; orientation and strength of the fracture field in the strait area and its relation with the active stress field study of possible temporal variation in the anisotropy parameters	2	2.3
D14	Processing of all available GPS data for the strait area, map of the horizontal strain-rate field and computation of the inter-seismic strain loading and deep geometry of the 1908 fault	2	2.4
D15	Modelling of the source responsible for the earthquake, by using a numeric approach (i.e. finite element)	2	2.4
D16	Database of focal mechanisms of earthquakes in the Messina Straits over the time period between 1988 and the end of the S5 Project	2	2.5
D17	Map of the stress tensor orientations and simulation of potential damaging earthquakes in the Messina Straits area	2	2.5

Deliverables – Test site Irpinia fault system

D18	Green's function database from ambient seismic noise for the ISNet network (Irpinia test-site)	3	3.1
D19	Resolution analysis for the cross-correlation technique at high frequency	3	3.1
D20	Refined re-picking arrival time catalogue and earthquake locations (Irpinia test-site)	3	3.2
D21	Parametric catalogue of micro-earthquakes including source parameters (Irpinia test-site)	3	3.2
D22	Digital 3 D velocity model including interface and event re-location (Irpinia test-site)	3	3.2-3.3
D23	Catalogue of reflected/converted phase arrival times from micro-earthquake data	3	3.3
D24	Acquisition, storage, analysis and modelling of high-rate GPS data in the Irpinia test site	3	3.4

Interaction with other S-projects

progetto	WP/RU	ACT #	Phase/Semester	I 1	2	II 1	2	risultato da condividere
S5		1.3	In the Alto Tiberina fault region:analysis of the GPS velocity field and derived products (strain rate, geodetic moment rate).				x	S1
S5		1.4	In the Alto Tiberina fault region: production of the isobath maps				x	S1
S5		1.5	In the Alto Tiberina fault region: production of the geological and geomorphological map and of the stratigraphic scheme of the area.				x	S1
S5		2.2	In the Messina Strait area: Integrated archive Earthquake refined locations Correlation of seismicity and active faults				x	S1; S4
S5		2.4	In the Messina Strait area:Evaluation of the velocity field from all the available data		x			S1
S5		2.4	Computation of the horizontal strain-rate field and of the inter-seismic strain loading and deep geometry of the 1908 Messina fault			x		S1
S5		2.5	In the Messina Strait area: hypocentral locations and FM computations with the additional contribution by the INGV experiment data				x	S1
S5		3.1	Real Time noise data management and processing	x	x	x		
S5		3.1	Dispersion curve analysis and tomographic inversion		x	x	x	
S5		3.2	Real-Time and off-line earthquake data management and processing	x	x	x		
S5		3.2	Refined picking , earthquake locations, tomographic velocity models		x	x		S1
S5		3.2	Earthquake Source parameters from inversion of spectral data			x	x	S1, S4
S5		3.3	Earthquake data gathering and standard seismic reflection processing	x	x			
S5		3.3	Reflection/converted phase identification and modelling			x	x	
S5		3.4	High rate GPS acquisition High-rate GPS processing	x	x			S1
S5		3.4	High-rate GPS procedure for alert systems. Analysis of earthquake detection thresholds			x	x	

Programma di oggi

10:30- 11:20 Task 1 – Test site "Alto-Tiberina"

11:20-12:10 Task 2– Test site "Stretto di Messina"

12:10-13:00 Task 3 – Test site "Irpinia"

» **Lunch Break**

14:00 – 15:00   Intra-Task meetings

» - Preparazione delle attività e dei prodotti del I° anno.

» - Previsioni per il II°anno

15:00 – 16:00   Discussione organizzativa e chiusura del meeting

Programma di oggi

Task 1 – Test site "Alto-Tiberina"

10.30 Intro Task 1

Responsabile: Lauro Chiaraluce, INGV - CNT

10.40 WP1.1: Building procedures to automatically manage and analyze seismic data.

Responsabile: Raffaele Di Stefano, INGV - CNT

10.45 WP1.2: Imaging the shallower portion of the Tiber basin to optimize drilling location.

Responsabile: Luigi Improta, INGV - Roma1

10.50 WP1.3: Velocity and strain rate fields from integration of regional GPS networks. *Responsabile: Nicola D'Agostino, INGV- Roma1*

10.55 WP1.4: Upper crust structure and tectonic evolution of the ATF Responsabile: Francesco *Responsabile*: *Mirabella, University of Perugia*

11.00 WP1.5: Tectonic evolution of the Tiber valley between Perugia and Città di Castello

Responsabile: Massimiliano R. Barchi, University of Perugia

11.05 Discussione

Programma di oggi

Task 2 – Test site "Stretto di Messina"

11.20 Intro Task 2

Responsabile: Lucia Margheriti, CNT-INGV

11.30 WP2.1 Ocean Bottom Seismographs deployment and test

Responsabile: Giuseppe D'Anna – Giorgio Mangano, INGV- CNT

11.35 WP2.2 Integrated seismic data bank and refined earthquake location to define seismogenetic structures

Responsabile: Milena Moretti , INGV-CNT

11.40 WP2.3 Seismic anisotropy

Responsabile: Davide Piccinini, INGV-Roma1

11.45 WP2.4 Ground deformation pattern of the Calabro-Peloritani area and the Messina Straits from GPS networks and terrestrial data

Responsabile: Mario Mattia, INGV- CT

11.50 WP2.5 Fault mechanisms and tectonic stress regime in the Messina strait

Responsabile: Giancarlo Neri, Università di Messina

11.55 Discussione

Programma di oggi

Task 3 – Test site "Irpinia"

12.10 Intro Task 3

Responsabile: Aldo Zollo, Università di Napoli "Federico II"

12.20 WP3.1 Seismic noise analysis and Green Functions

Responsabile: Gaetano Festa, Università di Napoli "Federico II"

12.25 WP3.2 Refined estimates of micro-earthquake source parameters

Responsabile: Claudio Satriano, Università di Napoli Federico II and AMRA scarl

12.30 WP3.3 Reflection seismology applied to micro-earthquake data

Responsabile: Nils Maercklin, Università di Napoli "Federico II"

12.35 WP3.4 High rate GPS for monitoring active seismic faults

Responsabile: Antonio Avallone, CNT-INGV

12.40 Discussione

GANTT: Example

Work Packages	Deliverables (RUs)	GANTT Task 1			
		S1	S2	S3	S4
WP 1.1	D1 (RU1, RU2)			*Development of the strategy*	*Application to a volcano*
	D2 (RU2)			*Prototype of the code*	*Manual of the code*
WP 1.2	D3		*Development of the strategy*		*Application to some case studies*
	D4		*Prototype of the software*		*Application to some case studies (e.g.,Etna and Pinatubo)*
	D5				*Summary Report*
WP 1.3	**D6**		*Prototype of the code*		*Application to some case studies*