The DIAS Outreach SEISMOLOGY IN SCHOOLS(Seismeolaíocht sa Scoil) Pilot Programme.

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During May 2008 the following headlines appeared in the major daily print media in Ireland:

Chinese tremor detected by students using seismometer in Co Wicklow, Irish Times 14/5/08

Young scientists detect quake in class, *Irish Independent, 14/05/08*

Wicklow students picked up China earthquake, *Irish Times, 22/05/08*

Wicklow students detect earthquake, *Wicklow Times, 28/05/08*

The background to these headlines was that a seismometer located in Scoil Chonglais VEC in Baltinglass, Co Wicklow, had recorded a very strong earthquake, magnitude 7.8 on the Richter Scale, in Sichuan, China, at 06.26UTC (07.26 Irish Time) on May 12th 2008. Students arriving to school that morning were able to see on the computer screen – shown in Figure 1 - the strong shock waves generated by the earthquake that had been recorded by their school seismometer.

The students and their Physics teacher Dr Stephen Gammell, in Scoil Chonglais are one of thirty-six schools throughout Ireland currently participating in the DIAS Seismology in Schools (Seismeolaíocht sa Scoil) Pilot Programme.

Background to the Pilot Programme.

An Outreach programme by the Geophysics Section of the School of Cosmic Physics in the Dublin Institute for Advanced Studies has been in operation for some years. Its main objective is to introduce the public, particularly young students, to the areas of scientific research currently being carried out in DIAS. The Seismology in Schools (Seismeolaíocht sa Scoil) Pilot Programme is our major new outreach initiative that introduces young students to the world of seismology and earthquake research. This is being undertaken by DIAS as part of DIAS's contribution to International Year of Planet Earth, IYPE.

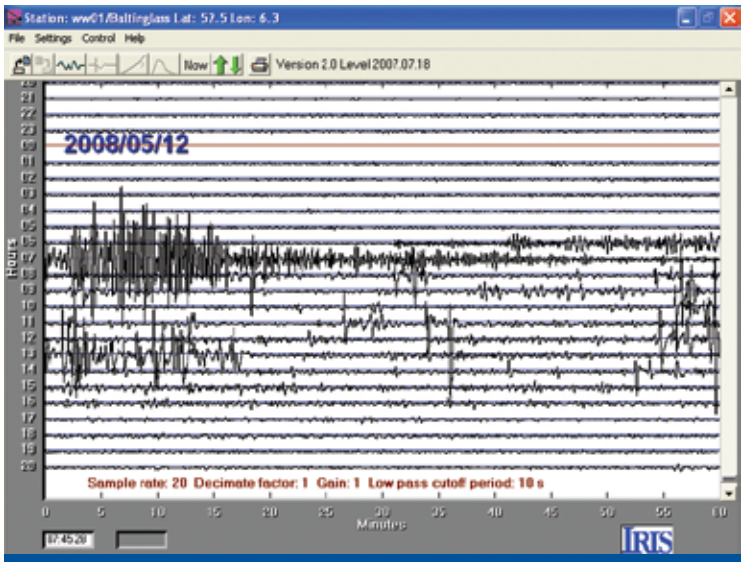

Fig 1, Seismogram of the horizontal ground motion caused by the Sichuan, China Earthquake recorded in Scoil Chonglais, VEC, Baltinglass, Co Wicklow. The computer screen simulates the original rotating drum or helicorder output which was used to display earthquake signals in the past. Each line represents an hour.

The Seismology in Schools concept started in the United States 13 years ago as the Princeton Earth Physics Project (PEPP) at Princeton University. From this the programme was expanded, and is now a highly successful programme currently run by the Incorporated Research Institutions for Seismology (IRIS) organization (see: www.iris.edu/edu/AS1.htm) with National Science Foundation funding. Currently almost one hundred schools across the U.S. are part of this programme. In Europe, the EduSeis programme (www.eduseis.net) is heavily rooted in the PEPP. EduSeis is an interdisciplinary programme that brings together geography, Earth sciences, mathematics, physics, technology and more. It creates a direct link between scientists and students. The first EduSeis station was installed in 1995 in the French Riviera.

Italy launched its own version of "Seismology in Schools" in 2001 (see: http://tinyurl.com/2feo3r), and currently some 200 schools are taking part. In both the US and Italy the recordings from the sensors in each of the schools are available to all of the other schools, and to schools not formally part of the

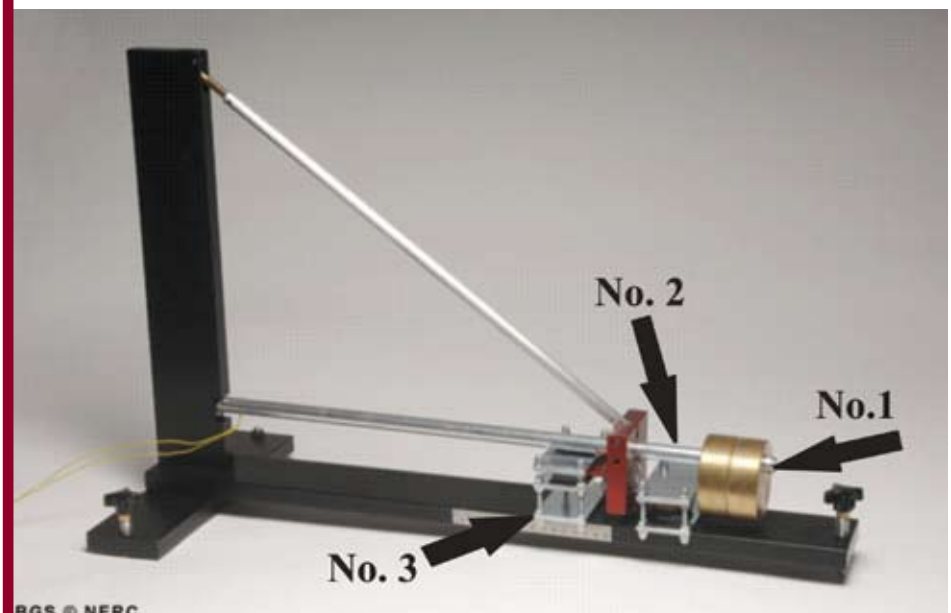

Fig. 2. SEP Seismometer (horizontal pendulum, garden-gate type sensor). No.1 is the seismometer mass, No.2 is the magnet & coil, No.3 is the damping gate.

programme, through the internet. Thus, students are able to see the progression of events as they march across their own countries. A similar system was also launched in France in 1996 (see: http://www.edusismo.org) and in Portugal in 2002 (see: http://web.educom.pt/eduseis/).

Recently, the U.K. also launched an equivalent initiative, through the British Geological Survey (see: www.bgs.ac.uk/schoolseismology/). Due to our collaboration with the BGS, we have been offered the opportunity to acquire very cost effective seismometers (SEP Science Enhancement Programme Seismometers see Fig. 2), which cost around €550, plus a further €150 for a custom-designed Perspex cover. The possibility of recording earthquakes in real-time in the classroom is a significant development in the classroom study of seismology and is the corner stone on which this initiative is based.

How does the seismometer work?

The seismometer is a Lehman pattern horizontal motion seismometer using a garden-gate offset suspension pendulum. It is partially based on a design by James D. Lehman, James Madison University, Harrisonburg, Virginia, USA. Pendulum seismometers are sensitive to signals at or above their natural oscillation frequency. The earthquake, when it occurs, produces compressional (P-waves) and shear waves (S-waves). To examine earthquakes, we are interested in detecting signals with frequencies of 1Hertz (1 cycle per second) for compressional waves (P-waves), 0.5 Hertz for shear-waves (S-waves) and 0.05 – 0.1 Hertz for surface waves. The geometry of the suspension allows this pendulum to have a natural period of up to 20 seconds (i.e., one cycle in 20 seconds, or frequency 0.05 Hertz). When the ground beneath the seismometer moves, the seismometer mass (see Fig. 2. No.1) will tend to stay where it is (due to its inertia) whereas the seismometer frame will move with the ground. The relative motion between the seismometer mass and the seismometer frame is converted to a voltage with a magnet and coil (see Fig.2 No.2). This voltage is digitized at 20 samples per second and displayed by the software on the computer screen as seen in Fig 1.

The seismometer is set up to record in quiet corners of the school grounds, preferably on "bedrock", and has a Perspex see-through cover to exclude air currents and other "noise" but still allow students to see it. The seismometer is attached to a digitizer and to a dedicated desktop/laptop computer running special software called AMASEIS. The system runs and records continuously. The software displays on the computer screen the shock waves that are created when a large earthquake occurs. In an average year there will be upwards of 100 such strong events worldwide that will be picked up by the seismometer for the students to see and examine.

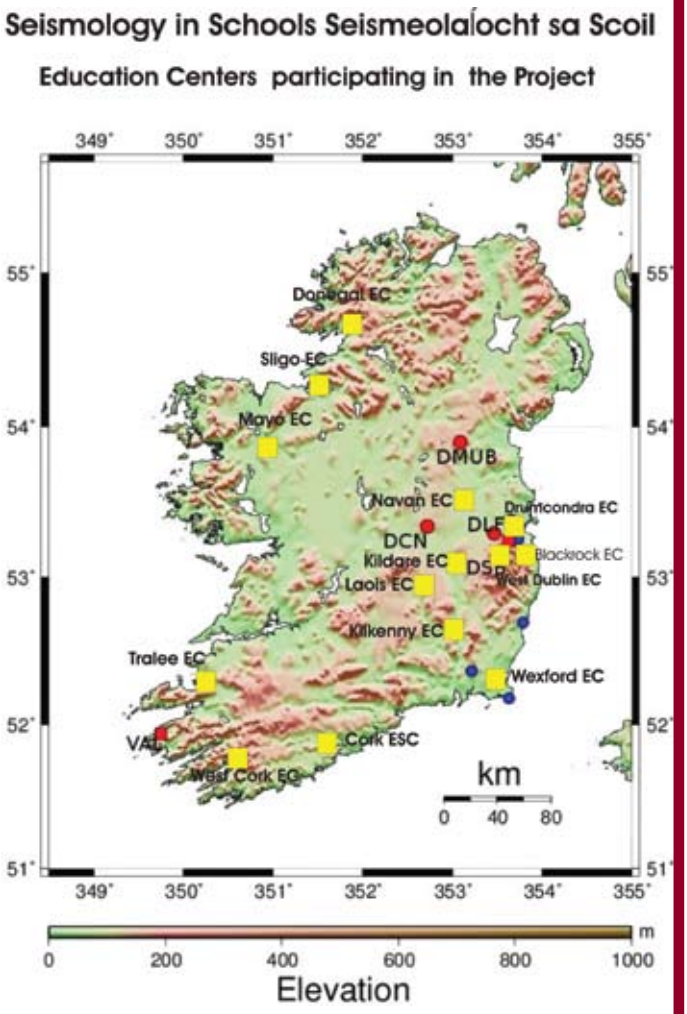

Fig. 3 Map of Education Centres (yellow squares) participating in the pilot programme. Current DIAS seismic recording stations (red dots & red square), unoccupied DIAS seismic stations (blue dots).

Partners in the DIAS Outreach Initiative

The Geophysics Section of the School of Cosmic Physics has been very fortunate to have partners in the pilot programme who bring considerable experience and expertise to the programme. IRIS (The Incorporated Institutes for Research Seismology) has developed the AMASEIS software that is used to display the data output from the seismometer. IRIS also provides a large amount of educational posters and demonstration software which is very useful in explaining Earth Science to students. The BGS (British Geological Survey) has been involved in the design and development of the seismometer itself, which is used for its own Seismology in Schools programme in the UK. DSE (Discover Science and Engineering) in Ireland is currently helping to fund the initiative, especially the training and development programme for teachers involved in the pilot programme run by DIAS. The ATECI (Association of Teachers/Education Centres in Ireland) has been a key player in this programme by agreeing to promote the initiative among their schools as part of its contribution to IYPE. The Geophysics Section has purchased seven seismometers and some of these are on loan to interested schools on a rotation basis. The ATECI (see Fig. 3) Education Support Centres around the country have purchased thirty-four seismometers which they have presented to selected schools , and the Geological Survey of Ireland (GSI) has purchased four seismometers.

Once the ATECI selected the participating schools and teachers for the pilot programme a series of workshops to "Train the Teachers" in the assembly, installation and use of the seismometer, and about general seismology, were held at selected Education Centres around the country.

Educational aspects

Once trained, educators, at both the primary and secondary levels can:

Fig. 4. A group of teachers at a Teacher Training Day

Set-up, calibrate, operate and troubleshoot their SEP seismometer.

Use data collected from their SEP seismometer as an integral part of their seismology/plate tectonics teaching

Participate as part of a larger community of educational seismometer users by making their SEP data available on the internet in real-time.

There are various learning outcomes depending on the educational sector being trained:

Students at primary level will be introduced to the working of the seismometer, how to construct it, how to protect it, how to use it, what it measures, how to use the data it produces, and what one can do with the data.

Once an earthquake has been recorded by the school seismometer, the students will use the workshop and internet material to locate where in the world the earthquake occurred, the parameters of the earthquake, the casualties and damage it caused and to write a small report for their local newspaper on the earthquake.

On a broader basis, the students will learn about the structure of the Earth and simple models to explain the interior of the Earth, plate tectonics and ideas about geological faulting. Material covered in class is reinforced by poster colouring projects of what has already been discussed.

The secondary school programme will introduce students to further aspects of seismology and to the Earth in general, and will emphasize the fundamental mathematics and physics laws on which seismology is based:

Co-ordinate geometry, x, y, and z axis 3 component systems, theory of elasticity, stress, strain and Hooke's Law.

Wave motion, P-waves, S-waves, Love waves and Raleigh waves, Snell's Law, dispersion, reflection and refraction.

History of the development of seismology, particularly the crucial role played by the 18th century, Irish scientist Robert Mallet (FRS), who gave the discipline its name and conducted the first-ever controlled-source experiment (on Killiney Beach in 1849).

How to locate an earthquake and interpret the data contained in a seismic trace.

Exchange and compare seismic data with schools in other countries of a given earthquake.

There is a significant amount of computer-animated teaching material also available to teachers for use in the classroom. A considerable amount of time will be spent by students researching and comparing earthquake recordings and on data exchange with other students that will require computer broadband facilities. The idea here is to simulate in the classroom for students, as near as possible, the day-to-day operations of a scientist (in this case a seismologist) and reinforce the role that science plays in everyday work.

Teacher Training programme

The "Train the Teacher" Workshops (Fig. 4) occurred in April-May 2008, with the assistance of the Education Centres throughout the country. A maximum of ten teachers attended each training workshop which included primary school teachers as well as secondary school teachers of both Physics and Geography (Fig. 4). The implementation of the pilot programme to date has been greatly assisted by the participation of Dublin City University 3rd year Environmental Science student Ms Grace Campbell. She is working with the Geophysics Section in DIAS for her INTRA (Integrated Training) six months training programme as part of her 3rd year university requirements.

After the workshops, the teachers were equipped with the necessary skills, information and demonstration programmes, to set up the seismometer and implement what was demonstrated in the workshop and start recording earthquakes.

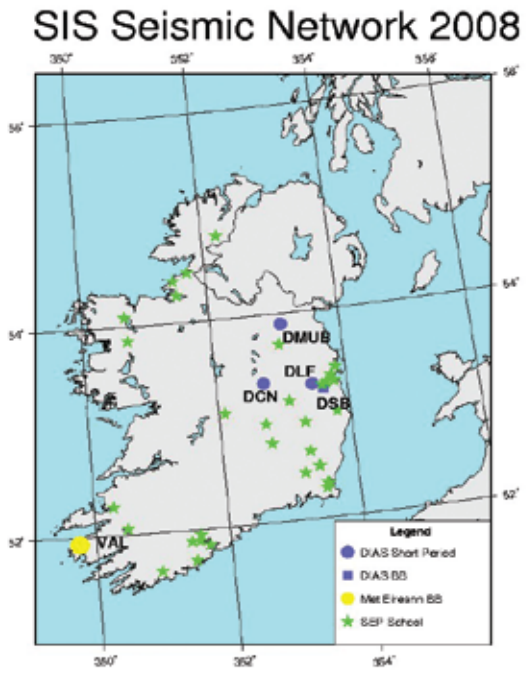

Fig. 5. shows the location of participating schools throughout Ireland, represented by green stars. The DIAS seismic recording stations are represented by the yellow and blue dots.

Participating Schools

There are currently thirty-six schools participating in the pilot programme; eighteen are primary schools, seventeen are secondary schools and one vocational training scheme. In primary schools the student focus is with the 5th and 6th classes. In the secondary school system, the pilot programme is seen as an excellent Transition Year project. Figure 5 shows that the schools are

dispersed throughout the country from County Donegal to County Wexford and West Cork. During the coming academic year the students in these schools will be actively involved in locating earthquakes, using the educational software and generally becoming more aware of the earth as a dynamic planet.

The participating primary schools are:

Riverstown NS (Primary)	Glanmine, Co Cork
Rushbrooke (Primary)	Cobh, Co Cork
Reenascreena NS (Primary)	Roscarbery Co.Cork
Robertson NS (Primary)	Stranorlar, Co Donegal
St. Josephs CBS (Primary)	Fairview, Dublin 3
Scoil Bhride Naofa (Primary)	Grey Abbey Rd. Kildare
Lisnafunchin NS (Primary)	Castlecomer, Co. Kilkenny
Scoil Eoin (Primary)	Tralee, Co Kerry
Ballyroan Boys NS (Primary)	Ballyroan, Co Laois
Crossmolina NS (Primary)	Crossmolina Co. Mayo
Carns NS (Primary)	Moneygold, Co. Sligo
Moneystown NS (Primary)	Roundwood, Co Wicklow
St Seanan's NS (Primary)	Enniscorthy Co. Wexford
St Adian's NS (Primary)	Enniscorthy Co. Wexford
Piercestown N.S (Primary)	Drinagh, Co. Wexford
Scoil Mhuire (Primary)	Coolcotts, Co. Wexford
St John of God's (Primary)	The Faytne Co. Wexford
St Joseph's NS (Primary)	Clonroche, Co. Wexford

The participating secondary schools are:

Colaiste Chriost Ri (Secondary)	Turner Cross, Co. Cork
Colaiste Choilim (Secondary)	Ballincolig, Co. Cork
Kinsale Community School	Kinsale, Co. Cork
Pres De la Salle (Secondary)	Bagenalstown, Co. Carlow
Magh Ene College (Secondary)	Bundoran, Co.Donegal
Malahide Community School	Malahide, Co. Dublin
St Colmcille Community School	Knocklyon, Dublin 16
St. Mac Daras Community College	Templeogue, Dublin 6W
Blackrock College (Secondary)	Rock Rd, Blackrock, Dublin
Sacred Heart (Secondary School)	Killinarden, Tallaght Dublin 26
Templeogue College (Secondary)	Templeogue, Dublin 6W
St Brigid's Secondary School	New Street, Killarney, Co. Kerry
Loreto Secondary school	Navan, Co. Meath
Davitt College (Secondary)	Castlebar, Co. Mayo
Vtos Birr (Secondary)	Roscrea Road, Co. Offaly
Ursuline College (Secondary)	Finisklin Rd, Co. Sligo
Scoil Chonglais (Secondary)	Baltinglass, Co.Wicklow
Colaiste Bride (Secondary)	Enniscorthy, Co. Wexford

Future plans

The enthusiastic welcome that the pilot programme has received from educators and students alike throughout the country has ensured a very positive start. However, this welcome has also been somewhat overwhelming for us at DIAS and, for management and logistical reasons, the pilot programme has had to be capped at its current level. The academic year 2008-2009 will be used to reinforce the material introduced in the workshops, develop regional groups of experienced teachers to act as local experts, and develop students' awareness of seismology in particular, and the Earth in general, by using the seismometer. Teachers and students will implement a programme of reporting on the earthquakes that the schools seismometer record throughout the year to DIAS and initiate the exchange of earthquake data between participating schools in Ireland by use of the internet. A medium term objective of the programme is to begin to "twin" Irish schools with other schools in Ireland initially, and then with schools in other countries that also operate a seismology in schools programme. The pilot programme will continue until April 2009 when a final report will be written to evaluate the success of the initiative and determine its future direction.

*For further information on seismology in schools and related matters please contact Tom Blake at tb@cp.dias.ie

TRANSNATIONAL GEOPARK – A WORLD FIRST?

Photo: Stalactites by EM Juleff

We reported in Issue 2 Autumn 2007 that the ***Marble Arch Caves Geopark***, already with European and Global Status, was planning to expand. The proposal would mean a considerable increase in size of the Geopark, with part of the expansion into West Cavan. The inclusion of part of Cavan certainly seemed logical, given that Cuilcagh Mountain, one of the landmarks of the current Geopark, is cut in two by the international border with the Republic of Ireland.

Talking to ***Richard Watson***, Head of the Geopark, I learnt that a UNESCO assessment team had recently visited. Their brief is to report back in September this year to the appropriate UNESCO committee for European Geoparks.

Hopes are high in Fermanagh and Cavan that the green light will be given for the expanded region to become the first international geopark in the world. Maybe in time for us to report it in Issue 5?

Editor