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DTI Strategic Environmental Assessment area 6 (SEA6) Geological Metadata

Continental Shelf & Margin Programme
Report CR/02/287

BRITISH GEOLOGICAL SURVEY

COMMISSIONED REPORT CR/02/287

DTI Strategic Environmental Assessment area 6 (SEA 6) Geological Metadata

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1. Introduction

This report describes work carried out under commission to the Department of Trade and Industry to compile an inventory of geological metadata for area SEA6 that may be applied to strategic environmental assessment. The area SEA6 is shown in Figure 1 and essentially covers the eastern Irish Sea, Cardigan Bay, and the St George's Channel. In accordance with the contract conditions, the database has been compiled in Endnote® format and produced on a compact disc (Appendix 1). It is largely based on the contractors' experience of work on geological interpretation of the area together with an extensive on-line literature survey.

The objective of the programme of research is based on the following questions:

1. What is the scope of data (published and unpublished references/references, data archives)?
2. Where is the original data stored?
3. What is the data quality?
4. How do we access data (include issues of costs and licensing)?
5. Brief narrative report geology and geological processes.

Department of Trade and Industry

Division of areas for
Strategic Environmental Assessment

SEA

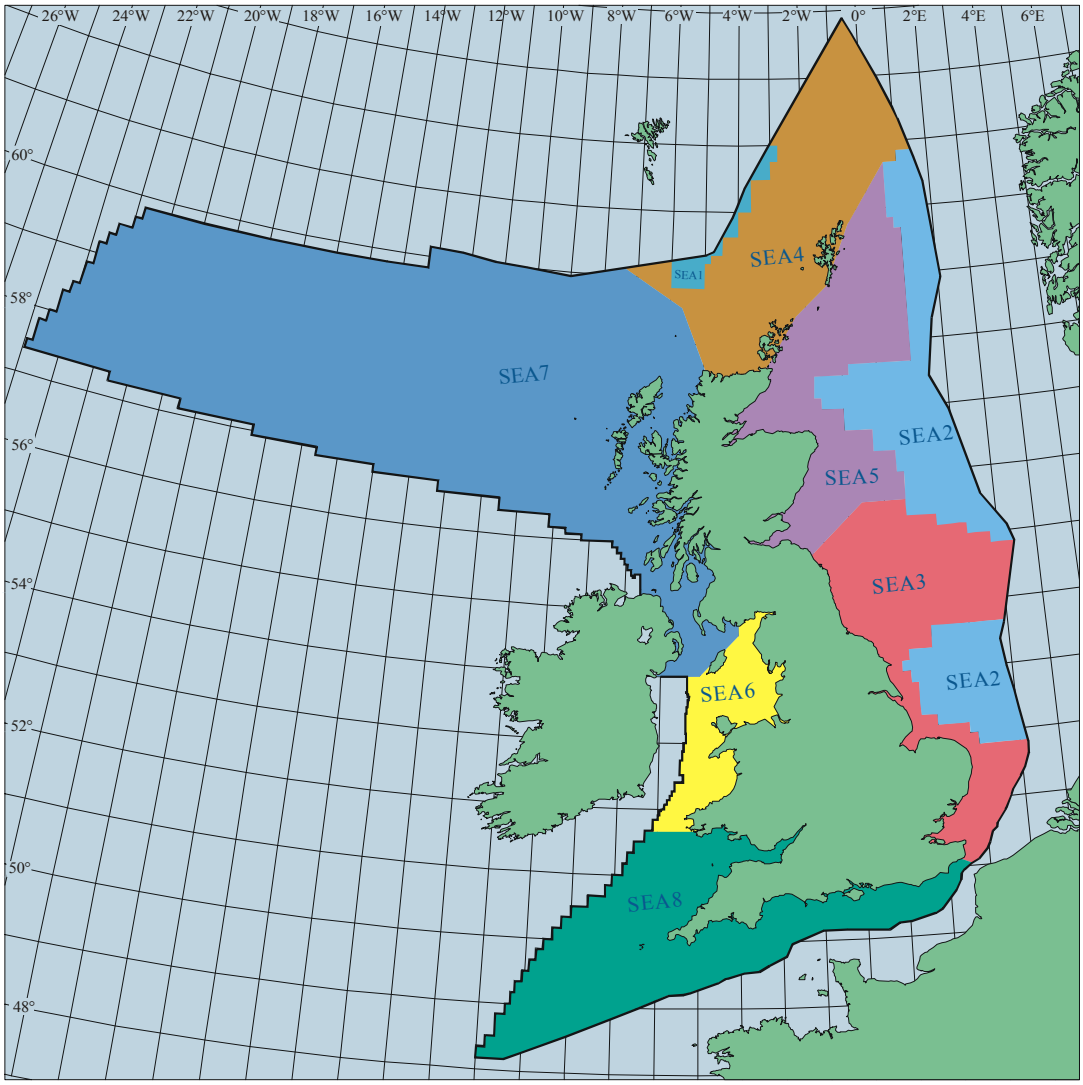

Figure 1 **Division of sea areas for strategic environmental assessment**

2. Synopsis

The area SEA6 is an almost completely enclosed sea that lies between Britain and Ireland. In the north the outlet is through the narrow North Channel between the Southern Uplands and Ireland, whereas in the south there is a broad outlet is into the Celtic Sea. Water depths are up 160m. Early sedimentary basin formation took place in the Palaeozoic and during the Mesozoic approximately 10 kilometres of sediments accumulated in a subsiding basin, one of the thickest sedimentary accumulations known on the United Kingdom shelf. There are up to 400m of Quaternary sediments underlying the St George's Channel and seabed sediment grades from gravel to mud.

There is a wealth of geological data for SEA6, although much of this is subsurface information on bedrock geology and structure. There is a considerable database of published articles on recent sediment distribution in the area as well as sedimentary processes now operating. For information we include in Appendix 2 a review of the morphological and recent sedimentary processes that bears upon environmental geology that is the subject of the contract.

Regarding subsurface and sedimentary geology, there has been a comprehensive programme of research undertaken by the British Geological Survey, in association with Universities such as Aberystwyth, as part of its remit to map the continental shelf during the 25 year Department of Energy contract that ran during the 1970's to 1990's. The objective of this contract was to provide published solid geology, quaternary geology and sediment distribution maps at 1:250,000 scale for the UK shelf. The area SEA6 is fully covered by this programme of research. In addition the culmination of the programme was a series of offshore reports describing the geology of the area SEA6. The relevant reports are referenced as Tappin et al., 1994 (Cardigan Bay and Bristol Channel) and Jackson et al., 1995 (East Irish Sea). The reference lists from both of these publications are included in Endnote© database provided. The mapping scale used by BGS in the offshore programme was at 1:100,000. Therefore each 1:250,000 scale map is composed of four 1:100,000 scale maps. At 1:100,000 scale the maps provide data on seismic traverses, sample locations and interpretations of the seabed sediments and seabed geology. The maps are available from the BGS as noted in the sources of metadata below, subject to IP conditions and cost of copying. BGS published data (reports and maps) are available at cost and identified as high quality (5) in the review carried out in Endnote©.

As well data actually acquired by the BGS for which we hold copyright, the BGS also hold non-BGS reports submitted or donated by commercial companies and Universities. There are almost 300 items in this collection. Some of this data we hold in confidence. If required we would pass on the name of the owner to DTI. Other items are available at cost, IPR constraints notwithstanding.

As well as the BGS publications there are numerous peer reviewed papers published in scientific journals. These papers are also referenced in the Endnote© database and carry a 5-category rating.

In the area SEA6 much sub-seabed data has been acquired by oil companies during periods of exploration. As is well known there are producing gas fields in the East Irish Sea. There are (non-commercial) oil finds in Cardigan Bay and the St George's Channel. There are many

special publications on the theme of hydrocarbons (e.g. Croker and Shannon, 1995; Meadows et al., 1997 and Shannon et al, 2001) that contain peer-reviewed articles on the geology of the area. There are numerous other articles that have been published in peer reviewed scientific journal and these carry a quality rating of 5.

Whereas the subsurface data may not be of immediate interest to this report, it should be noted that site-survey data acquired as part of the oil exploration may have a use in environmental assessment. There are a number of site-survey reports held at BGS, but most of these are confidential. Thus individual companies would have to be approached if access was required. There may be cost involved in this instance.

There are a number of metadata sites included in the report, not all of which have been reviewed in detail. However, it is considered likely that these sites may contain data of relevance to the present DTI project. Notwithstanding, there is a new project, recently set up by the Joint Nature Conservation Committee called 'The Irish Sea Pilot'. The objectives of the project are to trial a proposed new marine nature conservation framework in the Irish Sea, involving English Nature, Scottish Natural Heritage, Countryside Council for Wales, Environment and Heritage Service (N.I.). An essential aspect of the project is the setting up of a GIS. The web site for this initiative is appended.

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Croker, P.F. and Shannon .P.M. (Editors), 1995. The petroleum geology of Ireland's offshore Basins. Geological Society Special Publication, 93. Geological Society of London, 498 pp.
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Meadows, N., Trueblood, S., Hardman, M. and Cowan, G., (Editors), 1997. Petroleum geology of the Irish Sea and adjacent Areas. Special Publication 124, Geological Society of London. 447 pp.
Shannon, P.M., Haughton, P.D.W. and Corcoran, D.V. (Editors), 2001. The petroleum exploration of Ireland's offshore basins. Special Publication 188, The Geological Society of London, 469 pp.
Tappin, D.R., Chadwick, R.A., Jackson, A.A., Wingfield, R.T.R. and Smith, N.J.P., 1994. United Kingdom offshore regional report: the geology of Cardigan Bay and the Bristol Channel. HMSO for the British Geological Survey, London, 107 pp.

3. Methods

Along with previously accumulated personal bibliographic data sets, five online databases were searched in order to compile the inventory. Although this report deals with the environmental geology of SEA6, the contractors also compiled inventories of contamination for SEA6 as well as contamination and geology for areas SEA7 and SEA8. To avoid duplication of effort searches were carried out to cover both subjects in all three areas and the retrievals later sorted into separate Endnote© libraries for geology and the contamination of water and sediments in sea areas 6, 7 and 8. Searches were carried out on the basis of geographical and subject matter keywords (see 3.1 below).

Online bibliographic databases searched for journal, thesis and other references were:
Web of Science,

Georef,
GeoArchive,
Zetoc and
Aslib

Each search was repeated with all five databases, because they appear to hold slightly different collections of references.

The **Web of Science** online data set provides web access to ISI Science Citation Index, Social Sciences Citation Index, Arts and Humanities Citation Index, and Index to Scientific and Technical Proceedings.

The **Georef** online database, produced by the American Geological Institute, has 1.9 million bibliographic references across all geological subject areas. The North American literature has been indexed from 1785 onwards, and other areas from 1933. Journal articles, books, conference volumes, reports, maps etc are all covered. It is particularly good for searches of the geological journal literature

GeoArchive is an online bibliographic database covering all types of information sources in geoscience, hydroscience, and environmental science. The database is produced by Geosystems (UK) and is provided online by Oxmill Publishing.

Zetoc provides Z39.50 compliant access to the British Library Electronic Table of Contents. It covers the 20 000 most heavily requested journal titles from the British Library, and 16 000 conference proceedings per year. It contains 15 million items and is updated daily. Items are added within about 3 days of receipt. The database covers from 1993 onwards.

Aslib, consists of bibliographic records with abstracts, where available, for UK theses of all types and subjects. It covers theses accepted from years 1970 to 1999 and is the online equivalent of the printed index from volume 21 to 48 and parts 1-3 of volume 49.

Endnote© has inbuilt import filters for Web of Science and Georef and, using the import filter manager, completed searches from these databases load easily and straightforwardly into Endnote©, after downloading and saving as text or word documents. For GeoArchive it was necessary to create an Endnote© import filter, which was then saved within the Endnote© program filter collection to enable successful imports of the saved, tagged, word documents downloaded from searches. Zetoc was searched from within the Endnote© programme using the 'connect and search' function, enabling references to be loaded straight into the Endnote© library ready for manual filtering of relevant material. Individual records retrieved from the Aslib database were copied and pasted into a separate document to enable manual entry into the relevant Endnote© library.

An Endnote© output style was created to provide output in the same format as that specified in the contract for an Excel spreadsheet. For the Notes section of the output, journal articles are generally considered to be free and the data quality to be high (ranked 3 or higher). Where appropriate, journal articles have specific Notes attached.

3.1 KEYWORDS USED IN SEARCHING THE BIBLIOGRAPHIC DATABASES

Irish Sea	Bristol Channel	Petroleum
Liverpool Bay	English Channel	Quaternary
Solway Firth	Malin Sea	Holocene
North Channel	N.E. Atlantic Ocean	Seismic
Mersey Estuary	North Channel	Tectonics
Ribble Estuary	Isle of Man	Hydrocarbon
Sellafield	Dundalk Bay	Environment
Cardigan Bay	Burrow Head	Sea floor
St Georges Channel	Peel	Metal
Tremadoc Bay	Port Erin	Processes
Menai Straits	Deposition	Continental Shelf
Morecambe Bay	Sediments	Wales
South-West Approaches	Stratigraphy	
Celtic Sea	Geology	

Appendix 1 comprises a list containing references in Endnote© format.

3.2 BGS SCOPE OF DATA

BGS data sets comprise both BGS acquired data and non-BGS acquired data. There may be licensing issues for the BGS use of non-BGS data (e.g. Hydrographic Office sonar and bathymetric data) and/or with issue of BGS interpreted data with intellectual property rights (e.g. BGS digital bathymetry, seabed sediment, geochemical data)

3.2.1 BGS data

Regional Offshore Reports (bibliography held in Endnote©) available at cost
Non-confidential BGS reports likely to be released without charge into the public domain (grey literature).

Geophysical Survey data (data source from ORACLE database) including:

- Regional surveys - sub-seabed
  - Profile/sub seabed/seabed
  - Air gun
  - Sparker
  - Boomer
  - Pinger
- Regional surveys - Seabed only
  - Sidescan sonar
  - Swath bathymetry
  - Swath back scatter
  - 3D seabed returns

Sampling surveys

- Regional surveys
  - Sub-seabed (seabed secondary objectives)
    - Gravity core or similar
    - Vibrocore
    - Drill
  - Seabed (sub-seabed secondary objective)
    - Grab
    - Seabed photographs

Published maps (available at cost)

- Solid 1:250 000 hard copy
- Quaternary 1:250 000 hard copy
- Seabed sediments and bathymetry hard copy
- Solid 1:1000 000 hard copy
- Quaternary 1:1000 000 hard copy
- Seabed sediments and bathymetry 1:1000 000 hard copy

Digital interpreted data

- Seabed sediments texture and mineralogy
- Bathymetry
- Geochemistry (principally inorganic) but note the overlap with the contamination of seawater and seabed sediment components of the SEA programme of work

3.2.2 Non-BGS data

Non-confidential non-BGS reports are likely to be released without charge into the public domain (grey literature). These include:

Commercial site investigation reports. For well sites these would typically consist of 3x3 or 1x1km area surveyed with single- or multi-channel mini-sleeve/air gun, sparker, pinger/boomer/echosounder, sidescan sonar, with some interpretation calibrated by core. More problematic sites may have employed seabed photography, some with AUVs.

Aggregate surveys.

University survey reports

Hydrographic Office Series

- Sidescan sonar interpretation
- Single-beam echosounder (close survey)
- Sea bed samples of various types and qualities of interpretation

3.2.3 University College Cork, Department of Geology and Environmental Research data

Classes may be subdivided as above, with data sourced from Andy Wheeler.

3.2.4 United Kingdom and European metadata (Section 4)

Metadata data sources on network are from BGS (Alan Stevenson). Sources are listed below with HURL sites. There is likely to be huge dataset some of which may be too limited and time consuming (costly) to be of use for environmental surveys

4. Sources of metadata

Much of the assembled metadata is based on collections of reports, papers and other databases held at the British Geological Survey (BGS) and at the Dept. of Geology and Environmental Research, University College, Cork. These holdings have been supplemented by the literature searches outlined above.

Published BGS and University College, Cork reports and grey literature identified in the database will normally be available from BGS and Cork.

There are other metadata bases identified as potentially providing additional material, although there have been no exhaustive searches made of these. These are as follows:

- PAN NATIONAL AGENCY/DEPARTMENT/UNIVERSITY

- Joint Nature Conservancy Council:

  http://www.jncc.gov.uk

  With particular site:

  http://www.jncc.gov.uk/Marine/irishsea_pilot/default.htm

  for the new initiative 'Irish pilot project'

- Countryside Council for Wales:

  http://www.ccw.gov.uk

- Environment and Heritage Service: http://www.ehsni.gov.uk

- NGDF National Geospatial Data Framework (includes 'ask giraffe')
  www.ngdf.org.uk

- UKMIC UK Marine Information Council www.ukmarine.org

- IACMST . The Inter-Agency Committee on Marine Science and Technology
  http://www.marine.gov.uk/

  IACMST is a UK Government Committee reporting to the Office of Science and Technology. IACMST is responsible for the Marine Environmental Data Action Group (MEDAG), which, together with the Marine Environmental Data Co-ordinator, forms the UK Marine Environmental Data (UKMED) Network. The network has set up the OceanNET (http://www.oceannet.org/) web site as a portal to data and information about the marine environment. OceanNET also contains a new UK Directory of Coastal Data Sets. UKMED is currently funded by the Defence Science and Technology Laboratory (DSTL), Department for Environment, Food and Rural Affairs (DEFRA), the Environment Agency (EA), Fisheries Research Service (FRS), the Met Office, The Natural Environment Research Council (NERC) and the UK Hydrographic Office (UKHO).

- Marine equivalent of MAGIC needed www.magic.gov.uk, with possible start provided by www.cefas.co.uk

- INTRA-RESEARCH COUNCIL/UNIVERSITY

- www.NERC.ac.uk/data/

- INTRA-SURVEY/INSTITUTION

- www.bgs.ac.uk BGS Intranet/Geoscience/Metadata
- SOC http://www.soc.soton.ac.uk/cgi-bin/seadog/seadog.pl).
- List of searchable Databases (in addition to SOC SeaDOG) that contain references to cruises within the Area of SEA6

Database Name	URL
British Oceanographic	www.bodc.ac.uk

Data Centre	
National Geophysical Data Centre	www.ngdc.noaa.gov
European Directory of Marine Environmental Data (EDMED)	http://www.bodc.ac.uk/frames/index4.html?../services/edmed/index.html&2

- List of Sampling Databases. There are too many samples of many different type and age outside of BGS to make a sensible list. The SOC boscor site was not functioning October 2002.

Database Name	URL
BGS metadata	http://www.bgs.ac.uk/discoverymetadata/home.html
National Geophysical Data Centre	www.ngdc.noaa.gov

- PAN EUROPEAN

- GEIXS (Geological Information Exchange System) http://geixs.brgm.fr/
- EU-SEASED www.eu-seased.net. The EU-SEASED website consists of metadata from the following EC 4th and 5th Framework projects
    - EUMARSIN (European Marine Sediment Information Network)
    - EUROSEISMIC (European Marine Seismic Metadata and Information Centre)
    - EUROCORE (A searchable Internet database of seabed samples from the Ocean Basins held at European Institutions)
- SEASEARCH (Gateway to Oceanographic and Marine Data & Information in Europe) www.sea-search.net. Includes:
    - EDMED (European Directory of Marine Environmental Datasets)
- PANGAEA http://www.pangaea.de/

  PANGAEA is a public data library on the Internet aimed at archiving, publishing and distributing geocoded data with special emphasis on environmental, marine and geological research. It is operated by the Alfred Wegener Institute for Polar and Marine Research and the Centre for Marine Environmental Sciences at the University of Bremen.

APPENDIX 1

References in Endnote© format (on disc)

APPENDIX 2

SEA 6 SYNOPSIS OF MORPHOLOGY AND RECENT SEDIMENTARY PROCESSES

The area SEA6 is an almost completely enclosed sea lying between Britain and Ireland. In the north the outlet is through the narrow North Channel between the Southern Uplands and Ireland, whereas in the south the outlet is into the Celtic Sea. In the north, in the eastern Irish Sea, water depths are mainly less than 100m. However, west and south of the Isle of Man, the Celtic Trough is a deeper water feature that continues southward into the St George's Channel and the Celtic Sea, where water depths reach a maximum of 160m.

The present seabed morphology and sediment distribution is due mainly to glaciogenic processes operating over the past several 100,000 years. Five bathymetric zones are recognised (Tappin et al., 1994; Jackson et al., 1995):

1. Coastal embayments: 50% intertidal and up to 10m deep formed during the Holocene sealevel rise (Eyles and McCabe 1989),
2. Inner Shelf platforms: up to 100km in width in the East Irish Sea with gentle gradients of 1:100 to 1:2000. Water depths are mainly up to 60m, except in the south where there are depths of 100m. The platforms formed at times of lowered sealevel during the last (Weichselian) glaciation.
3. The Celtic Trough: a linear feature that runs from west of the Isle of Man to the Celtic Sea. Water depths are generally at 110m but are as great 160m, and seafloor gradient is subdued (1:50). The origin of the trough is problematic, although it is not structural. It is an erosive feature, almost certainly formed at lower sealevels associated with glacial maxima, probably during the mid or early Pleistocene (Eyles and McCabe 1989).
4. Rocky prominences: mainly areas of rough seabed topography, found in: coastal embayments where they are represented by rocky headlands or shoals; on the inner shelf where they are islands and shoals; and where sedimentary rocks are exposed at seabed. Those at less than 25m water depth were formed during the Holocene transgression (Eyles and McCabe 1989).
5. Enclosed Deeps: less than 5km wide, up to 30km long and 10 to 50m deeper than the surrounding sea floor. Gradients are less that 1:10. They are found on the inner-shelf platform and within the Celtic Trough. They formed as kettle holes during the early Holocene (Eyles and McCabe 1989).

Seabed sediments range from gravel to mud and two units (layers A and B) are recognised as being actively involved in the present-day hydraulic regime (Pantin and Evans, 1984). Layer A is the mobile sediment, with a patchy distribution. It comprises mud, sand and gravel grade and over much of the area is up to 0.3m thick. In the East Irish Sea there is a general transition southeast and east from the Isle of Man and towards the coast from coarser-grained gravel and sand to mud that forms a mud belt, termed the Western Irish Sea Mud Belt (Belderson, 1964). Within the sandy and gravelly areas there are extensive fields of sand ribbons and sand waves as well as barchan dunes. Sediment in these sand and gravel areas is

up to 40m thick (Wingfield, 1987 and James and Wingfield, 1987). In the St Georges Channel and Cardigan Bay areas there is a dominance of coarser sand and gravel that also forms seabed features similar to those in the Irish Sea.

Layer B underlies Layer A and comprises a relict deposit of gravel and sand, often a pebbly coquina or gravel. It is generally up to 0.2, thick. Where Layer A is absent Layer B is part of the active system and the fine-grained component is being winnowed and removed. Off the Welsh coast there are relict glacial outwash features termed Sarns.

The controls on the present day sedimentation regime include climate, tidal currents, bathymetry, sediment input and distance from source. The climate is temperate with a dominance of westerly winds, with those above Force 8 recorded between 35 and 45 days per year. The exposure of the southern part of the area to the open ocean in the south ensures abundant wave action that is effective mainly along the coast, and leads to active erosion in this zone, which thereby provides a sediment source. There is a diurnal tidal regime with maximum surface velocities of $1.0m/s^{-1}$ that results in bed-load partings being located off Pembrokeshire and the Lleyn Peninsular. Thus the dominant bed-load transport direction is southward (into the Celtic Sea) and northward (into the Irish Sea) from the Lleyn/Anglesey area. There is a positive correlation between areas of maximum bed-load stress and maximum erosion. In the area of the bed-load parting off Anglesey the seabed is swept clean of sediment. The floor of the Celtic Trough is composed of coarse sand and gravel. In the east of the Irish Sea, where there is an area of slack tide, the seabed comprises mud.

Underlying the seabed sediment there are a series of sedimentary basins (Tappin et al., 1994; Jackson et al., 1995). North of Anglesey the rocks are mainly of early and pre-Mesozoic age with a Quaternary cover up to ~100m thick. In this area there are a number of producing gas fields. South of Anglesey there are accumulations of Mesozoic rocks, which in places are over 10km thick. There is an overlying Quaternary cover up to 400m thick. There has been an active hydrocarbon exploration programme here but limited commercial accumulations have as yet been discovered.

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