36th INTERNATIONAL GEOLOGICAL CONGRESS 2020

BID DOCUMENT

SAN SEBASTIÁN
SPAIN

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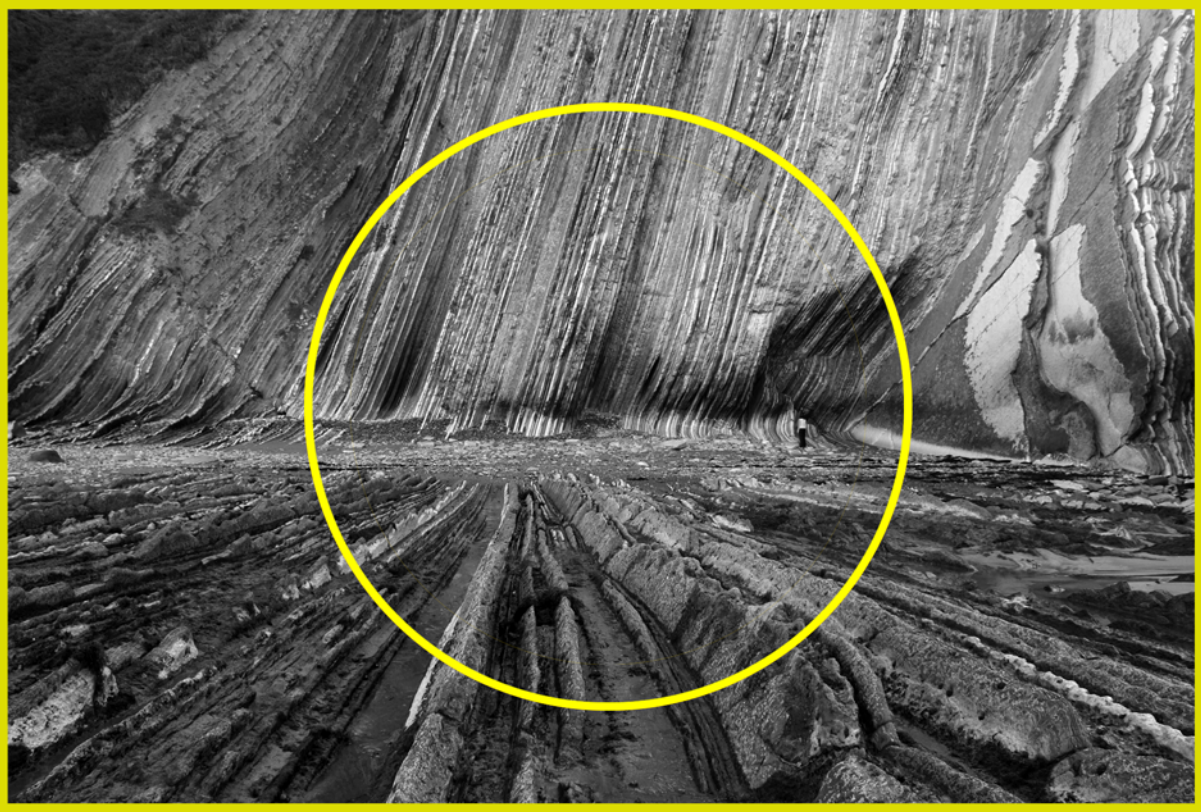
THE SPANISH BID



36th INTERNATIONAL GEOLOGICAL CONGRESS SAN SEBASTIÁN, 2020

Submitted by

Geological Survey of Spain (IGME)

Contents

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EXECUTIVE SUMMARY.

WHY SPAIN?

1. Geologically speaking, the Iberian peninsula is like a microcontinent, as it hosts the most varied geological heritage in the whole Europe. A Variscan basement surrounded by three alpine ranges with very different structural features, show the scars left in Spain of its existence as an isolated tectonic plate during part of its geological time. Such a complete array of tectonic settings and sedimentary basins, which spans from the Neoproterozoic to the present day are the result of its hazardous geological history. The volcanic archipelago of the Canary Islands adds value to the already impressive geology of Spain.

2. Spain is one of the countries of the world with a better detailed knowledge of its geological substrate, as it has a 1:50.000 scale geological map of the whole continental territory (1:25.000 in the islands), resulting from the works carried out by the Geological Survey of Spain (IGME). IGME, a senior institution created in 1849 has included in those maps all the geological and mining knowledge accumulated by IGME itself in its own research and development projects, as well as the knowledge of many other national and international, public and private geosciences institutions or even mining companies. The Survey hosts, and makes publicly available, an impressive amount of subsoil data which has helped in the interpretation of the deep crust structure of the Alpine and Variscan orogens.

3. With a wide climatic variety, active tectonics and volcanic activity, Spain has developed a complete survey of their quaternary geology expressed in geomorphologic and active processes maps, as a tool for planning land use and prevent natural hazards.

4. Spain constitutes a major research and training site for researches of universities and mining & oil companies all around the world. Its magnificently exposed sedimentary basins, orogens and volcanoes provide examples of worldwide reference. For example the north-western Variscan Massif, shown a complete section (350 km) of a great collision Palaeozoic chain; the record of Pyrenean orogeny preserved in their synorogenic deposits; the registry of the Mediterranean sea Messinian drying crisis and their surrounding reefs; the Aptian-Albian extensional carbonate episode of Basque-Cantabrian basin; the Iberian and Betics ranges; the Ebro, Duero and Tagus basins continental record, etc.

5. Spain records the history of three orogenic episodes: Cadomian, Variscan and Alpine cycles. The extension of the Variscan Orogen outcrop is the biggest in Europe. The knowledge of these orogens has increased wildly in the last few years with the images of the Spanish lithosphere structure obtained from deep reflection seismic profiles such as ESCI, IBERSEIS and ALCUDIA in the Iberian Variscan Massif, and ECORS in the Pyrenean Alpine Orogen, among others.

6. Spain has preserved a unique record of the history of life from late Neoproterozoic to Quaternary, both in marine and continental ecosystems, among which we can bring out the famous paleontological sites for invertebrate fossils of Río Huso (Toledo: Neoproterozoic-Cambrian), Murero (Zaragoza: Cambrian), Cabañeros (Ciudad Real: Ordovician), Checa (Guadalajara: Silurian), Arnao (Asturias: Devonian), El Soplao (Cantabria: Cretaceous amber), Albarracín (Teruel: Jurassic), or Rubielos de Mora (Teruel: Miocene). Among the paleontological sites of plant fossils are noteworthy several Carboniferous coal basins of northern and central Spain, the Aragoncillo Permian forest and the Miocene of La Cerdanya (Lleida) and Rubielos de Mora (Teruel), the later bearing interesting fossil insects. The main dinosaur track sites are in the Jurassic of Asturias and the Cretaceous of Fumanya and the Cameros basin. Famous vertebrate fossil localities are the lithographic limestone of Montral-Alcover (Tarragona: Triassic), the fossil-lake of Las Hoyas (Cuenca: Cretaceous), several dinosaur fossil sites such as Lo Hueco (Cuenca) and Teruel, and a number of Neogene and Quaternary mammal localities, among them the Pliocene site of Fonelas (Granada) and the early Pleistocene sites with human fossils occurring at the Sierra de Atapuerca (Burgos).

7. The mining history in Spain is one of the lengthy and richer of the entire globe, existing well-preserved mining sites from prehistoric to Roman, Medieval and present times. Spanish mineral deposits are rated between the largest and more important around the world. Some world class deposits are the massive sulphide deposits of Riotinto Pyritic Belt, Reocin Zn-Pb and Almadén Hg ores and the Potash Catalan-Navarre basin.

8. Spain is also a global actor in the production of dimensional stone, as is the sixth world natural stone producer. In particular is the world´s largest roofing slates producer from the Valdeorras-La Cabrera range region, located in the margin of the West Asturian-Leonese Zone. Spain is

also world leader in the production of certain industrial minerals and rocks: 2nd world producer of celestite (Granada Tertiary basin), sole European sodium sulphate producer (several Tertiary deposits in Madrid and Burgos), 2nd fluorspar European producer (Asturias), and 3rd world producer of gypsum, and a long etc.

9. Spain holds seven UNESCO Geoparks which display the wide variety of its geological heritage. Most Spanish National Parks are placed in areas of key geological interest, from the heart of the Pyrenees to the active volcanic areas in the Canary Islands. Comprehensive geological information and detailed geological guides of these areas are available.

10. Spain holds an unique records of stratigraphic event episodes: the GSSPs of the Danian-Selandian and Selandian-Thanetian boundaries (Paleocene series) and worldwide reference sections of both the K-Pg, and PETM (Paleocene-Eocene Thermal Maximum) are located in Zumaia, few miles away from the proposed conference centre. Some other reference sections and GSSPs for the Middle Jurassic and the Eocene are located in Spain.

11. Spain is also an extraordinary site for the study of volcanism. Non only it hosts a vast volcanically active province such as the Canary Islands where the birth of a new submarine volcano has recently taken place (El Hierro), but preserves an ample record of old volcanic rocks from all geological times from Cambrian to recent times. The country also has extraordinarily preserved volcanos in Campo de Calatrava (Ciudad Real) and La Garrotxa (Catalonia) as well as rare ultrapotassic volcanics associations in SE Iberia.

13. The development of the science of Sedimentology owns a lot to Spanish outcrops. Many sedimentological models are based in Spanish examples such as the turbidities models of the Eocene south-Pyrenean basin, the fluvial and lacustrine deposits of the Ebro and Duero basin, carbonate reef models based in Messinian examples in the Mediterranean and the carbonatic turbiditites of the Betics among others. Sedimentological studies are rooted in a deep stratigraphic knowledge backed by abundant palaeontological and paleomagnetic data.

13. Of the old European massifs, the Variscan basement of the Iberian Peninsula, since it has been also subjected to the Alpine orogeny is, no doubt, the one with more geomorphological singularities such as the Appalachian reliefs, the fluvial grouts and the “rañas”. The interaction of old precenozoic elements with the Alpine renewal has resulted in extraordinary landscapes where one can perceive the testimony of almost 295 millions years of geological history.

14. Spain is a paradise for karst research. There is a great number of karstic caves which stand out because of its depth: 18 of more than 1000 m; by its length: 4 of more than 100 km; by its speleothems: Valporquero in León, El Soplao in Cantabria or Nerja in Malaga; by its prehistoric art: Altamira in Cantabria, Tito Bustillo and Candamo in Asturias, among other; or by its human remains: Atapuerca in Burgos or El Sidrón in Asturias. We can also point out beautiful karstic landscapes of the Picos de Europa mountains, located between Asturias, León and Cantabria, El Torcal de Antequera in Málaga, The Enchanted City of Cuenca and the Monte Perdido Massif, the highest karstic system of Europe.

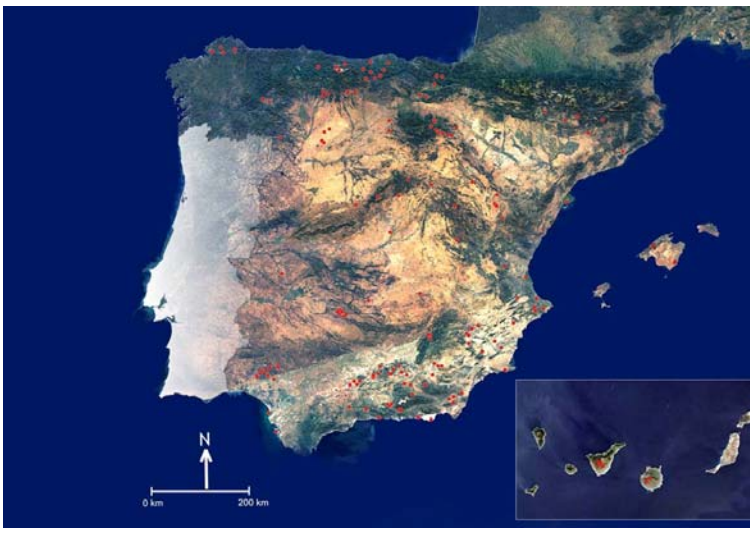
15. Spain is a country with a great social interest in geology as attested by a large list of museums and collections of palaeontology, mining and natural history. Examples of these are the Museo Geominero, the Natural Sciences Museum both in Madrid, the Human Evolution Museum in Burgos, Dinópolis, Jurassic Museum and Mining Museum in Asturias, as well as widely distributed interpretation centres in natural areas of geological interest. The education in Geology is carried out in 11 Universities in Spain. The location of geology faculties is generally related with the traditional places where geology has been a recognized topic in the sciences catalogue or related with the existence of important mineral resources in the region. There are faculties of geology in Madrid, Barcelona and Oviedo, and geology departments within faculties of sciences in Granada, Salamanca, Madrid, Barcelona and the Basque Country. Or individual departments in the Universities of Huelva, Zaragoza or Valencia. There are also many institutions carrying out geological research in Spain (IGME, CSIC, etc), both at national and regional level (EVE, ICC, Junta de Andalucía etc).

16. Spain hosted its only and very successful International Geological Congress in 1926 (XIV International Geological Congress), almost 100 years from 2020, the proposed year for the Congress requested in this bid. It is time to renew and revise the geological knowledge of the Iberian Peninsula that this long span of time has represented for the global geological knowledge.

17. The conference venue, the International Convention Centre in San Sebastian is located in one of the most beautiful settings in the world and probably the best place for enjoy eating in the entire globe. It is renowned for its Basque cuisine. San Sebastian and its surrounding area is home to a high concentration of restaurants boasting Michelin stars. In September, the San Sebastian International Film Festival comes to the spotlight, an event with more than 50 years. The city of San Sebastian was selected European Capital of Culture for 2016.

MAJOR GEOLOGICAL FEATURES OF SPAIN

The geology of Spain is remarkably diverse. It includes one of the most complete Palaeozoic sedimentary successions in Europe, and an excellent record of the effects of the Variscan orogeny on the margins of the former supercontinent of Gondwana. In addition, post-Variscan Mesozoic and Cenozoic strata are widely exposed across the eastern half of Spain, from the Cantabrian and Pyrenean mountains to the Betic Cordillera and Balearic Islands. These successions and their fauna reveal a unique Iberian palaeogeography influences both by the widening Atlantic Ocean to the west and by events in the Tethys Ocean and Alpine-Himalayan orogen to the east. Alpine collision in Cenozoic times has created spectacular mountain belts in which the effects of both collisional and extensional processes can be observed. Neogene and Quaternary volcanism has occurred in southern, south-central and eastern mainland Spain, and the magnificent Canarias volcanoes expose one of the world's classic hot-spot-related ocean islands chains. Volcanism has taken place in the Canaries for over 20 Ma, and all stages of its volcanic evolution are preserved, from the early build-up of submarine seamounts to the emergence, growth and polyphase collapse of major subaerial volcanoes. In addition to recent volcanism, the Quaternary record in Spain encompasses many environments, from glacial to semi-desert, from Mediterranean to Atlantic, and includes the hugely important hominid site of Atapuerca. Not only has this astonishing site yielded over 3000 middle Pleistocene human fossils from some 30 individuals living around 300 000 years ago, but there are also lower Pleistocene hominid remains more than 780 000 years old.



Satellite view of continental Spain and its islands.

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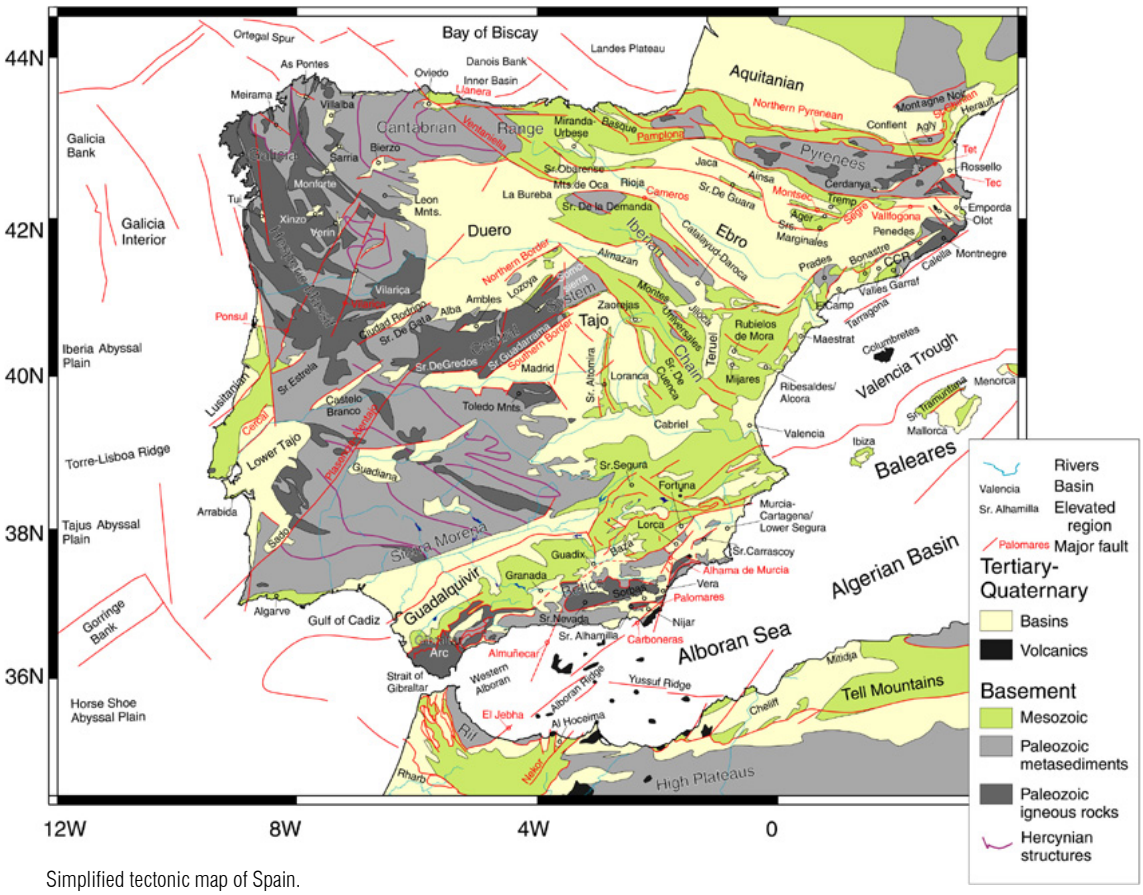
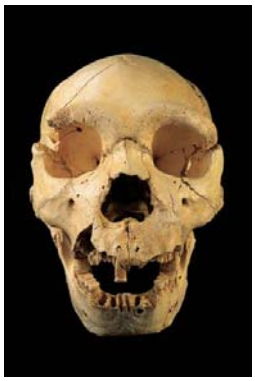


Simplified tectonic map of Spain.

Peak of Teide, volcanic peak at the centre of the island of Tenerife, Canary Islands.

Early Pleistocene sites with human fossils occurring at the Atapuerca Mountains (Burgos).

The geological diversity of Spain is reflected in its mineral wealth. The oldest evidence for organized mines goes back to the Tartessan civilization that existed in Andalusia around 3000 years ago. A key reason for Roman invasion, and subsequent close links between Iberia and the Roman Empire, was the abundance of metallic ores (especially gold) in the peninsula. Palaeozoic rocks in Spain host by far the most productive and historically important mercury mine in the world (Almadén), as well as the famous supergiant metallic deposits of the Iberian Pyrite Belt. There are abundant coal deposits, the exploitation of which, although now in decline, played a key role in the industrialization of Spain over the last 150 years. The majority of mineral exploitation activity these days is concentrated on industrial minerals, especially on those used in the construction industry. In this context Spain continued to maintain it position as a world class producer of slate, marble, granite, celestite, fluorite, gypsum and many other industrial minerals, whilst still complying with increasing environmental controls on mineral exploitation. Also of importance and concern are the country's water reserves, the distribution of which is dependent on the highly varied geography and climate. Rainfall varies from over 1600 mm/year in the north, to 300 mm/year in the south (and even less in the Canary Islands), and further global warming could have dramatic consequences on an already stressed hydrological system.



Homo heidelbergensis, Atapuerca fossil site
(© Javier Trueba-Madrid Scientific Films).

The Queen of Spain and the Ministry of Science visiting the world famous Atapuerca fossil locality

Spanish physical geography directly reflects the underlying geology, with the present geomorphology having been created primarily by Cenozoic events linked to the Alpine orogeny. Wedged between the African and Eurasian continental plates, Spain is bordered by two great mountain chains, namely the Pyrenees-Basque-Cantabria belt in the north, and the Betic Cordillera in the south. Both mountain ranges include peaks above 3000 m, with the highest point in mainland Spain being Mulhacén (3481 m) in the Betic Sierra Nevada. These two mountain chains broadly define the northern and southern margins of an Iberian continental plate that existed independently prior to Cenozoic orogeny. Alpine collision initially occurred in the north, where Pyrenean Iberia became partly subducted beneath the Eurasian plate. The focus of Alpine deformation then switched to the southern margin, where Ibero-African collision produced the Betics, a mountain range that subsequently underwent dramatic extensional collapse. Both of these collision zones have generated classical examples of foreland basins: the Ebro Basin immediately south of the Pyrenees, and the Guadalquivir basin north of the Betics. The Ebro basin is bordered to the south by the high hills of the NW-SE trending Iberian Ranges, a focus for Alpine intraplate deformation. In contrast, the Guadalquivir basin is bordered to the north by the Sierra Morena, where Alpine overprint is much less obvious.

Rio Tinto mines in the Iberian Pyrite Belt.

Creatceous limestones cropping in the "Alpine Spain" (Benidorm, Alicante province).

Away from the mountainous northern and southern margins of Iberia, central Spain is dominated by two large Cenozoic basins, drained by the Tajo river in the south, and the Duero river in the north. These basins form high, relatively flat areas known as "mesetas", and are separated by the NE-SW trending, granite-dominated highlands of the Central Range (Sistema Central). The latter range represents another zone of Alpine intraplate deformation, and has "popped up" basement rocks on reverse faults to produce mountain peaks that in the highest area (Sierra de Gredos) locally exceed 2500 m. Unlike the Iberian Ranges, which represent the inversion of a former Mesozoic sedimentary basin, the Central Range had little post-Variscan cover and is characterized by Palaeozoic granitic and metamorphic basement. This basement also appears west of the Duero and Tajo basins to form extensive and structurally complex outcrops from Sierra Morena in the south to the Atlantic coast of Galicia. Thus the western side of the country is sometimes referred to as "Variscan" Spain, the Palaeozoic outcrop of which forms the "Iberian Massif", in contrast to "Alpine Spain" to the east where the geology is dominated by Mesozoic and Cenozoic sediments and young mountain belts.

Viewing Spain in terms of western "Variscan" and eastern "Alpine" areas is, of course, a simplification. There are inliers of pre-Mesozoic Variscan rocks within the Pyrenees, Iberian Ranges and the Betic Cordillera, all overprinted by various degrees of Alpine tectonometamorphism. Similarly, far-field effects of the Alpine orogeny are detectable across the western side of Spain, well away from "Alpine" Spain. Furthermore, pre-Variscan exposures in the west, and especially SW, include Precambrian as well as Palaeozoic rocks. These Precambrian rocks include a record of events along an ancient active plate margin, the evolution of which is commonly referred to as Cadomian orogeny. The southwestern part of "Variscan" Spain, in the area known as the Ossa Morena Zone, thus includes Cadomian magmatic arc-related rocks that subsequently became part of the passive gondwanan shelf. Spain was therefore assembled from three (Cadomian, Variscan, Alpine) rather than just two orogenic cycles, although relatively little is preserved of the oldest of these.

Meander of the Tagus river in the city of Toledo.

Sierra de Gredos, Central Range.

Ordovician Algodor-Milagro syncline in the Toledo Mountains, Central Iberian Zone.

IBERIAN MASSIF

The above-mentioned Ossa Morena Zone is one of several tectonostratigraphic zones that traditionally have been recognized in the Iberian Massif since the work of Lotze in 1945. From north to south these zones are the Cantabrian (CZ), West Asturian-Leonese (WALZ), Central Iberian (CIZ), Ossa Morena (OMZ) and South Portuguese (SPZ). All these areas, except the SPZ, lay on the northern margin of the "African" part of Gondwana during Cambrian to Devonian times and preserve thick marine successions and volcanic rocks. Cambrian sedimentary rocks are widely distributed across the Iberian Massif, as well as in northeastern and eastern Spain, and essentially comprise a diachronous carbonate succession lying between two siliciclastic sequences. Ordovician sedimentary rocks (and their fossils) are similarly widely distributed and are characterized by siliciclastic sediments deposited on the Gondwanan margin at high latitudes. By the end of the Ordovician period the Iberian area had drifted northwards to around 50ºS, a trend that continued through Silurian time when the deposition of a mostly siliciclastic succession included widespread sedimentation of grapolitic black shales. Devonian sedimentation took place in warm temperate to subtropical seas (*c.* 35ºS latitude in Early Devonian), in places producing thick carbonates that include remarkable reefal deposits. The deposition of Carboniferous strata was essentially coeval with Variscan deformation, when the whole Palaeozoic Gondwanan shelf sequence was variously deformed and metamorphosed during collision between Gondwana and Laurentia. In order to help the reader obtain a simple overview of the Iberian Massif, each of its constituent zones is briefly considered below.

"Las Catedrales" beach, in the Galician coast of Lugo.

The largest Iberian Massif zone is the heterogeneous Central Iberian Zone. The CIZ is divided into a northern part (Lotze's Galician-Castilian Zone, these days commonly referred to as the Domain of Recumbent Folds) and a southern part (Lotze's East Lusitanian-Alcudian Zone, commonly referred to as the Domain of Vertical Folds), the difference being mainly one of Variscan tectonic style, metamorphic grade, and magmatic intrusion history. CIZ rocks become increasingly deformed and metamorphosed towards the NW where they are overlain by exotic nappes stacked over the continental margin during Variscan collision. This exotic belt, now exposed in NW Spain, is normally referred to as the Allochthonous Complexes or Galicia-Trás-os-Montes Zone, and exposes a spectacular range of metamorphic lithologies that include ophiolitic rocks, eclogites and high pressure granulites, some of which have been exhumed from depths of over 50 km.

Ordovician trilobite *Toletanaspis*, from the Central Iberian Zone.

To the north of the CIZ, the West-Asturian Leonese Zone exposes Precambrian to Devonian metasediments that were strongly folded and foliated by three Variscan (Late Carboniferous) deformation phases. The boundaries of this zone are tectonic, and, as with the CIZ, metamorphic grade and deformation intensity both increase westward along the zone. The contiguous Cantabrian Zone exposes only a relatively small area of Precambrian rocks but shows an excellent, thick Palaeozoic succession (including the largest outcrop of Carboniferous rocks in Spain) that has undergone strong Variscan shortening. The zone is essentially a thin-skinned fold-and-thrust belt, with classic foreland propagating deformation affecting virtually unmetamorphosed sediments. It thus represents the most external of the areas affected by Variscan collision. A remarkable feature of this zone is its strongly arcuate shape (the Ibero-Armorican arc), with a concavity facing eastwards towards the external part of the orogen.

Carboniferous rocks in the "Picos de Europa", Cantabrian Zone.

Grey Carboniferous limestones at Cain de Valdeón, León province (Picos de Europa National Park).

To the south of the CIZ and OMZ, the South Portuguese Zone forms the SW margin of the Iberian Massif. This zone was an exotic terrane unrelated to Iberia prior to Variscan collision, and the Upper Palaeozoic successions in this zone (exposures include only Devonian and Carboniferous rocks) are deformed by south-vergent thrusting. The boundary between the SPZ and the OMZ includes blueschists and mélanges and represents a suture zone between Gondwanan Iberia (OMZ) and what was probably a part of Avalonia.

Overall, the Iberian Massif can be viewed as a thick Palaeozoic Gondwanan shelf sequence of sediments and extension-related volcanic rocks, with a Proterozoic (Pan African/Cadomian) basement. During Variscan collision this sequence was overridden by exotic nappes in the NW, and was obliquely thrust over the SPZ (Avalonia) to the south. Polyphase deformation and crustal thickening of the Iberian sequence induced widespread metamorphism, initially (D1) of compressional Barrovian type, then (D2) of lower pressure, extension related type. Extensive partial melting during D2 produced what are now some of the largest and best preserved syntectonic and post-tectonic granitoid outcrops in the European Variscides. Magmatism continued in some areas into post-Variscan (Permian) times when extensional fault-related continental sedimentary basins developed around highland areas. Thus the scene became set for a long period of Mesozoic subsidence and sedimentation on and around the eroded remnants of the Variscan orogen.

MESOZOIC PALAEOGEOGRAPHY AND SEDIMENTATION

Encroachment of the Neotethys ocean from the east during Triassic time gradually encircled and isolated subsiding Iberian area, creating a Pyrenean-Cantabrian basin to the north, and a Betic basin to the south. Diachronous marine transgression led to a change in many places from the deposition of continental clastic successions (Buntsandstein facies) to shallow marine carobantes separated by mudstone-evaporite units (Muschelkalk and Keuper facies). Triassic marine successions are well developed in the east Cantabrians, the Pyrenees and Catalonian Coastal Ranges, the Iberian Ranges, and the Betics.

Late Triassic-Early Jurassic rifting, linked to the separation of Africa and North America, enhanced the spread of Tethyan seas. Central and western Iberia (the Iberian Massif) continued to form an emergent area through Jurassic time, but reduced in size by further encroachment of shallow epicontinental seas from the north and NE (Asturias, Basque-Cantabrian and South Pyrenean basins), east (Iberian basin), and south.

Cretaceous limestones, Santillana del Mar (Cantabrian Zone). Note the chapel built in the core of the anticline.

The latter southern margin formed a wide Lower Jurassic carbonate shelf bordering a narrow oceanic trough that connected Tethys with the widening central Atlantic ocean, and separated Iberia from Africa. Extensional break-up of this Betic shelf created offshore pelagic and hemipelagic troughs and swells where Middle-Upper Jurassic marl-limestone successions and condensed sequences (such as the famous "ammonitico rosso" facies) were deposited. Along the eastern side of Spain (Iberian basin and southern Catalonian Coastal

Ranges), normal faults again controlled the palaeobathymetry, and a long and complex history of Jurassic sedimentation ensued, depositing mostly limestone and marl. To the north, carbonate-dominated platform sedimentation initially continued in the Basque-Cantabrian-South Pyrenean basin, where the fauna record a palaeogeography transitional between Atlantic and Tethyan waters. Upper Jurassic marine regression induced widespread erosion and continental sedimentation (Purbeck) in northern Spain, a change linked directly to the onset of rifting in the Bay of Biscay.

The initiation of North Atlantic oceanic spreading at the beginning of the Cretaceous period provided the primary control over subsequent Iberian palaeogeography and sedimentation, although both climate and eustatic sea level changes were also important. The low-lying Iberian Massif remainded the largest landmass, had a subtropical, maritime climate, and was surrounded by warm seas in which carbonate deposition was mostly dominant. During periods of high relative sea level, most notably during rapid Atlantic spreading in mid-Cretaceous times, much of Iberia became flooded, and a broad Iberian basin connected the Betic area with the Bay of Biscay. As with the Jurassic record, Cretaceous marine fossils thus show a double affinity with northern and southern faunal provinces.

For much of Early Cretaceous time Iberia underwent extension and transtension, with varying (but commonly rapid) subsidence rates in the various basins to the south, east and north. In the south, shallow marine sediments (Prebetic) graded into deeper water pelagic limestones and marls (Subbetic), although the Jurassic separation of the area into well-defined troughs and swells tended to decline over the Cretaceous period. Further south still, away from from Iberia, turbiditic sediments derived from Africa and areas to the east produced Cretaceous "flysch" sequences.

Cretaceous/Paleogene Zumaian flysch (Basque Country).

Northwards from the Betics, the intracratonic Iberian basin covered much of eastern Spain during Cretaceous time. Initial

Exokarstic relief in Cretaceous limestone from the "Ciudad Encantada" (Enchanted City), Cuenca province.

rifting in this area produced four strongly subsident sub-basins containing thick, continental to shallow marinesuccessions of Early Cretaceous age. During Late Cretaceous times this Iberian basin initially expanded during eustatic sea-level rise to form a wide, shallow seaway in which developed the largest expanse of carbonate platforms ever seen in Iberia. At this time of maximum flooding, the only emergent areas in Spain were the Iberian Massif in the west, and a smaller island of Variscan basement in the NE (the Ebro Massif). Latest Cretaceous marine regression across the eastern half of Spain later led to the re-emergence and widening of land areas, and was linked to tectonic movements during the early stages of the Alpine orogeny.

Along the northern margin of Iberia, extensional break-up of the old Jurassic platform initially created several depocentres in which thick, marine Lower Cretaceous successions were deposited. This setting was replaced by more active mid-Cretaceous transtension linked to the Bay of Biscay, with strong tectonism producing pull-apart flysch basins, the emplacement of mantle rocks, and low pressure-high over a period of some 30 Ma before finally becoming caught between Africa and Europe during Late Cretaceous oblique convergence.

ALPINE OROGENY

The NW margin of Spain became a focus for convergence as early as mid-Cretaceous times, when the oceanic crust of the Bay of Biscay began to be subducted beneath Iberia, creating an accretionary prism. Continental collision, however, did not begin until Late Cretaceous times and was initiated in the eastern Pyrenean area, subsequentñy propagating westwards as the Iberian plate was obliquely subducted beneath the Eurasian plate. Rapidly subsiding troughs, filling with turbiditic "flysch" sediments, became involved in sysnsedimenatry thrusting. Nearer shore in northeastern Iberia, Pyrenean sequences show a complex evolution involving initial coastal

onlap and expansion of carbonate sedimentation, flowed by platform collapse and extensive olistostrome generation. The Pyrenees-Basque-Cantabrian region shows good preservation of synorogenic sedimentary successions, despite widespread Cenozoic uplift that has created unconformity between most Cretaceous and Tertiary strata. The Pyrenees is thus a mountain range formed by the inversion of a Mesozoic passive to transtensional plate margin. Convergence continued over some 60 Ma, from late Cretaceous to middle Miocene times, with thrusting being directed northwards and southwards away from a central axial zone (where Variscan basement rocks crop out) and towards two foreland basins, the Aquitaine basin in France, and the Ebro basin in Spain. During this time interval, northward movement of the Iberian plate induced a progressive climatic change from tropical through humid subtropical and eventually to arid subtropical conditions.

Jurassic limestones forming the spectacular karstic reliefs of the "Torcal de Antequera", Malaga province.

Further south from the Pyrenees, in the Iberian basin, the onset of Alpine compression produced newly emergent highs separated by increasingly isolated depocentres, with the sea retreating both northwards and southwards from the intracratonic area. Intraplate stress fields, transmitted from the Iberian plate margins, reactivated formerly normal faults to form a thrust system that ultimately inverted the basin and so created the Iberian Ranges. Compressive deformation started in the early-middle Eocene interval and tended to progress westwards, reaching a peak in late Oligocene times but continuing throughout much of the Miocene epoch. Further west from the Iberian Ranges, intraplate stress resulted in the emergence of the Central Range and the separation of central Spain into the Tajo and Duero basins, with the main phase of uplift taking place as recently as around 10 Ma BP.

Along the southern Iberian margin, Alpine collision occurred later than in the Iberian Ranges, so that sedimentation continued interrupted across the Cretaceous-Tertiary boundary in many places. The change from the transtensional setting that had characterized Iberian-African interactions since Triassic times, to one involving Cenozoic convergence, was to generate a new palaeogeography and ultimately produce the Betic Cordillera. The Betics form the westernmost Alpine mountain belt in Europe and are subdivided into an Internal Zone, generally metamorphosed and derived from the south, and an External Zone, which represents the deformed southern Iberian margin. The Internal Zone forms a crustal wedge that was stacked over southern Iberia at the beginning of Neogene times. During the Miocene epoch deformation propagated into the Iberian margin, producing imbricate thrust stacks of Mesozoic and Palaeogene strata and creating the Guadalquivir foreland basin. Wholesale extensional collapse of the Betic mountains induced rapid exhumation of the Internal Zone and generated a series of continental and marine intermontane basins, most of which opened towards the Mediterranean Sea. Particularly noteworthy of these Neogene sedimentary successions in southern Spain is the presence of thick gypsum beds deposited in response to the Messinian salinity crisis, when the Mediterranean dried out around 5.5 Ma BP.

"Bárdenas Reales" badlands, Saragossa province.

Neogene-Quaternary crustal extension has played an important role in generating the landscape of southern and eastern Spain. It has created not just the "Spaghetti Western" basin-and-range topography of the internal Betic Cordillera, but has produced extensive normal faulting in the Iberian Ranges and along the eastern coast, bordering the highly subsident Valencian trough. Cenozoic extension of Iberian crust has facilitated the extrusion of alkaline basalts in south-central (Calatrava volcanic field) and NE (around Gerona) Spain. The more dramatic extensional belt running from the Valencian trough to the Betics was linked to the eruption of calc-alkaline to ultrapotassic rocks, the best exposures of which are preserved in the Almería area of southern Spain.

Neotectonic studies show that the primary compressive stress in Spain is oriented NW-SE, as Africa continues to push against Iberia. The focus of deformation continued to be in southern Spain where the wide, diffuse Ibero-African plate margin is converging at a rate of 4 mm/year. Seismicity associated with this convergence is concentrated in the south, but also transmitted to central and northern Spain by a notework of active Quaternay faults that are currently most active in the Pyrenees and, to a much lesser extent, in the

Iberian Ranges and Galicia. Although Spain is not generally recognized as a country of significant seismic risk, at least ten major, destructive earthquakes have occurred over the last ten years. The great Lisbon earthquake of 1755, for example, had its epicentre below the Gulf of Cádix and was felt all over Spain, from the Portuguese border to Catalonia. Thus the Alpine orogeny continues in Spain today, a country lying across the long-active geological boundary between NW Africa and Western Europe.

Soutwestern margin of the Sierra Nevada Range (Betic Cordillera).

La Larri glacial valley in the Pyrenees, Huesca province (Ordesa and Monte Perdido National Park).

(Text reproduced from Gibbons, W. & Moreno, M.T. 2002. Introduction and overview. *In*: Gibbons, W. & Moreno, M.T. (eds) *The Geology of Spain*. Geological Society, London).

GEOSCIENCES IN SPAIN

Spain has a long and fruitful tradition of geosciences research. The result of that long tradition is a extremely dense network of research organisations at all levels (national and regional) and in all the fields of geosciences. Follows a non-exhaustive summary of those organizations.

A. NATIONAL RESEARCH ORGANIZATIONS

1. GEOLOGICAL SURVEY OF SPAIN (IGME): THE MAIN NATIONAL CENTRE ON EARTH SCIENCES RESEARCH, INFORMATION AND DOCUMENTATION

IGME is a Public Research Institution of the Ministry of Science and Innovation and National Geological Survey. Since 1849 the Survey produces basic infrastructural knowledge of the territory, including its resources, and provides web access to the databases and geo-scientific information systems that develops. The Institute is also the National Reference centre for natural hazards and soils.

Its main **mission** is to provide to public administrations, economic agents an Society in general, information technical-scientific assistance and advice concerning Earth sciences and technologies to be used in land-use planning.

IGME premises, including headquarters, 12 regional offices in several places around the country, laboratories, warehouses, library and museum, all have advanced equipment and technical resources. Its drill-core repository in Cordoba is an unique and spectacular facility in Spain, where drill core and geochemical samples are stored, handled and managed. The institution has also diverse scientific-technical outreach tools, such as the Bureau of Transference of Research Results (OTRI), the Documents Centre, the Publication Centre, the Geominero Museum and the best national specialized library.

Its main scientific-technological activity can be summarized in the following strategic research programmes:

- Geo-scientific mapping

The program is a basic reference of the Survey since it creation in 1849. Production of the geo-scientific maps of the country –in a systematic way or by users demand- using new technologies and integrating associated geo-referenced databases.

- Mineral resources and environmental impact of mining

Study and research on mineral resources, from the geological processes conditioning their presence to environmental-mining planning and recovery and reclaiming of mining sites using sustainability criteria.

- Hydrogeology & environmental quality

Study of the quality and quantity of the available underground water resources for a rational exploitation and of the impacts and stresses they are subjected to.

- Geological Hazards, active processes & global change

Study and characterization of the most common physical processes and geological hazards affecting Spain in emerged and in the costal and submarine areas. Floods, earthquakes, volcanism, landslides and coastal erosion are, due to their social an economic significance, the main natural phenomena studied by this program.

- Subsoil Geology & CO_2 Geological Storage

One of our main activities in support of the mitigation of the effects of the Climatic Change and with the aim of deepening in the knowledge of the structure and physical properties of the subsoil of the country, integrating multidisciplinary information on geology, hydrogeology, geophysics, boreholes, etc.

- Geodiversity, Geological and Mining Heritage and Scientific Culture.

Mineralogical, paleontological and geological research projects to maintain, update and raise awareness of the moveable heritage of the Museo Geominero (Geo-Mining Museum). Creation and diffusion of scientific culture in its widest sense, especially in relation to the conservation and publicizing of its important geological and cultural resources including historic bibliographic and cartographic collections on earth sciences.

- Geo-scientific information systems

Creation of geo-scientific data models in updated computerized platforms and development and implementation of systems to release those models via internet, facilitating users access and download.

The encouraging and diffusion of all this activities intends to strengthen the research carried out by IGME and its capacity as a scientific and technical advisor to the various administrations and to the industry. In order to do that, the growing sensibility of the Society on matters such as geological hazards, sustainable use of underground waters, soil pollution, environmental impact of mining and the mitigation of Climate Change have all been taking into account in agreement with international standards.

One essential objective is to increase IGME´s scientific and technical productivity, arranging multidisciplinary teams in a more efficient manner and in response to those new challenges.

2. SPANISH RESEARCH COUNCIL (CSIC)

The Spanish State Agency Research Council (CSIC) is the largest public institution dedicated to research in Spain and the third largest in Europe. Belonging to the Spanish Ministry of Science and Innovation through the Secretary of State for Research, its main objective is to develop and promote research that will help bring about scientific and technological progress, and it is prepared to collaborate with Spanish and foreign entities in order to achieve this aim. According to its Statute (article 4), its mission is *to foster, coordinate, develop and promote scientific and technological research, of a multidisciplinary nature, in order to contribute to advancing knowledge and economic, social and cultural development, as well as to train staff and advise public and private entities on this matter.*

CSIC plays an important role in scientific and technological policy, since it encompasses an area that takes in everything from basic research to the transfer of knowledge to the productive sector. Its research is driven by its centres and institutes, which are spread across all the autonomous regions, and its more than 15,000 staff, of whom ore than 3,000 are staff researchers and the same number again are doctors and scientists who are still training. CSIC has 6% of all the staff dedicated to Research and Development in Spain, and they generate approximately 20% of all scientific production in the country. It also manages a range of important facilities; the most complete and extensive network of specialist libraries, and also has joint research units.

CSIC covers all fields of knowledge. Its activity, which covers everything from basic research to technological development, is organised around eight scientific-technical areas:

- Area 1. Humanities and Social Sciences
- Area 2. Biology and Biomedicine
- Area 3. Natural Resources
- Area 4. Agricultural Sciences
- Area 5. Physical Science and Technologies
- Area 6. Materials Science and Technology
- Area 7. Food Science and Technology
- Area 8. Chemical Science and Technology

Its main functions are:

- Multidisciplinary scientific and technical research
- Scientific and technical advice
- Transfer of results to the business sector
- Contribution to creation of technologically-based companies
- Training of specialist staff
- Management of infrastructures and large facilities
- Promotion of the culture of Science
- Scientific representation of Spain at international level

Its main areas of research in geosciences are the Natural Resources Area and the Materials Area.

Natural Resources Area

The main mission of CSIC's Natural Resources Area is to contribute to the scientific understanding of the Earth and the living beings that inhabit it, studying the structure and functioning of nature. The Area's research is organised in five fields:

- Evolutionary systematics and biology, including lines of research focusing on the description of the systematic component (taxonomic and phylogenetic) of Biodiversity, as well as understanding of the evolutionary mechanisms that have created it, based on comparative methods.
- Ecology and conservation of biodiversity, with research based on describing and modelling interaction between species in ecosystems. This encompasses the ecology of populations, communities, behaviour and co-evolution. This research generates knowledge to be used in managing and mitigating human impacts on ecosystems, in order to conserve them.
- Processes in the hydro-geosphere, researching the responses of the terrestrial and atmospheric systems to climatic variability and natural and/or manmade environmental changes. It also includes climate-related hydrological risks, desertification processes and the transport of contaminants and solid particles in the atmosphere and soils. This scientific research has immediate implications from a socioeconomic point of

view and in terms of the quality of life of human populations.

- Internal composition and processes of the Earth, researching the physical-chemical properties and inner architecture of our planet by combining methods in geophysics, structural geology, petrology, geochemistry and mineralogy. This research has a great impact on aspects of human activity such as sustainable exploration and exploitation of mineral and energy resources and the storage of waste and gases.
- Research and technology of Ocean processes, studying the physical, chemical, biological and geological processes that underlie the functioning of the oceans, thereby generating essential knowledge for sustainably managing coastal uses and services, the exploitation of species as a part of the ecosystem, mapping of the continental platform and the oceans' response to manmade pressures, both locally and globally.

It is also possible to identify a cross-cutting thematic axis running throughout this entire Area, focused on global change. Whether in a multidisciplinary way or through concrete lines of research, this area can help us to understand and mitigate the effects of systemic and cumulative changes to the planet being caused by human activity.

Research in this area is structured in institutes and it is also supported by various singular facilities, some of the most important are:

- ORV Hespérides
- ORV Sarmiento de Gamboa
- Juan Carlos I Antarctic Base
- OceanBit coastal observation platform
- Field research stations such as the Doñana Scientific Reserve
- The Cap Ses Salines Lighthouse
- Royal Botanic Garden
- National Science Natural Museum

List of Centres within the Natural Resources Area, related to Geosciences

- DESERTIFICATION RESEARCH CENTER. VALENCIA
- MEDITERRANEAN CENTRE OF MARINE AND ENVIRONMENTAL RESEARCH (CMIMA). CATALONIA
- EXPERIMENTAL STATION OF ARID ZONES (EEZA). ANDALUCIA
- ANDALUSIAN INSTITUTE OF EARTH SICENCES. ANDALUCIA
- INSTITUTE OF EARTH SCIENCES JAUME ALMERA (ICTJA). CATALONIA
- INSTITUTE OF MARINE SCIENCE (ICM). CATALONIA
- INSTITUTE FOR ENVIRONMENTAL DIAGNOSIS AND WATER STUDIES (IDAEA). CATALONIA
- GEOSCIENCES INSTITUTE (IGEO). MADRID.
- INSTITUTE OF MARINE RESEARCH (IIM). GALICIA.
- INSTITUTE OF NATURAL RESOURCES AND AGROBIOLOGY (IRNAS). ANDALUCIA
- MEDITERRANEAN INSTITUTE OF ADVANCED STUDIES (IMEDEA). BALEARIC ISLANDS
- NATURAL SCIENCES NATIONAL MUSEUM. MADRID.
- MARINE TECHNOLOGY UNIT (UTM). CATALONIA

Materials Science and Technology Area

The CSIC Area of Materials Science and Technologies promotes the advancement of scientific knowledge and technological development of materials to be used by society. Materials can be applied to new uses by improving and changing their properties through innovative treatments and processing. In a similar way, putting imagination to use in order to meet these objectives will produce new materials with properties never before imagined.

This area has three essential objectives:

- To generate and disseminate knowledge and transfer it to industry
- To create new scientists and technicians
- To provide advice to society in general in the area of materials

The area of Materials Science is intrinsically multidisciplinary and, by necessity, must focus on the physical-chemical aspects of matter in order to meet practical needs in sectors as varied as construction or nanomedicine.
The Area encompasses many lines of research that are connected to or have common areas of action with other areas, especially with the Area of Physics and the Area of Chemistry, contributing knowledge from the most basic scientific aspects of materials right through to the technological development of their applications.

- Functional and multifunctional materials
- Structural materials for sectors of high industrial interest
- Materials and engineering for construction
- Design, modelling and simulation of materials
- New manufacturing and processing methods
- The properties of materials at nanometric scale
- Large facilities for studying and characterising materials
- The study, understanding, conservation and restoration of Historical and Cultural Heritage

List of Centres within the Area of Materials Science and Technologies with close relation with Geosciences

- INSTITUTO DE CERAMICA Y VIDRIO (ICV). MADRID
- INSTITUTO DE CIENCIAS DE LA CONSTRUCCION EDUARDO TORROJA (IETCC). MADRID

Other Geosciences CSIC Centers

- ASTROBIOLOGY CENTER. MADRID

3. SPANISH INSTITUTE OF OCEANOGRAPHY (IEO)

The Spanish Institute of Oceanography is a public research institution attached to the Ministry of Science and Innovation, devoted to marine sciences, particularly in all related to the scientific knowledge of oceans, the sustainability of fisheries and the marine environment. IEO does not only carry out basic and applied research, it also advises scientifically and technologically all administrations in matter related with oceanography and marine sciences. IEO is the scientific and technological representative in most of the international organisms and for a related with the sea and its resources. IEO is an autonomous research institution, with a staff of around 700 employees, of which 80% are researchers.
IEO has its headquarters in Madrid and nine coastal oceanographic centers in: A Coruña, Balearic islands (Palma), Cadiz, Canary Islands (Tenerife), Gijón, Malaga, Murcia, Santander and Vigo; five experimental plant for marine cultivation; twelve mareographic stations and one satellite image reception. Its oceanographic fleet, with more than twenty boats, has six main oceanographic vessels. The IEO carries out basic and applied research works in oceanography and marine sciences, as well as other services for the scientific and technological development and the maintenance of industrial, social and commercial activities, with the aim of increasing the scientific knowledge of the oceans and its sustainable use.
Its main functions are:

- Scientific research in oceanography and marine science and the multidisciplinary study of the oceans.
- Advise to the Administration in its fishery policy and in marine sciences in general.
- Official representation of Spain in international organizations of fisheries and marine science
- Promotion of the cooperation in marine research at regional, national an international scale.
- Train marine researchers and promote marine oceanography knowledge

4. NATIONAL GEOGRAPHIC INSTITUTE (IGN)

The National Geographic Institute is a research and development institution attached to the Ministry of Public Works, whose main functions are:

- Planning and management of the astronomic infrastructures and instrumentation, particularly for the development of tools useful in geodesy and geophysics.
- Planning and management of the national geodesic network, of the high precision topographic network and the mareographs network.
- Planning and management of the system of detection and communication of earthquakes in Spain and surroundings, as well as developing studies and works on seismicity and earthquake-resistant standards.
- Planning and management of the systems of detection and communication of the volcanic activity in Spain and related hazards. Management of the geophysical observation systems and development of the gravimetric and magnetic mapping works.
- Production and update of the national topographic and cartographic base and its integration in geographical information systems and to produce

the National Topographic Map and associated and derived mapping, including the National Spanish Atlas and associated thematic mapping.

- Management and development of national land observatory plans with geographic and cartographic uses. Production and development of digital terrain models from aero-spatial images.
- Technical and operative support to the Higher Geographic Council. Management of the Central Cartographic Database.
- Planning and management of the National Geographic Information Infrastructure.

5. CENTER FOR TECHNOLOGICAL, ENERGY AND ENVIRONMENTAL RESEARCH (CIEMAT)

The CIEMAT, an Organism of the Ministry of Science and Innovation, is a Public Research Agency for excellence in energy and environment, as well as in many vanguard technologies and in various areas of fundamental research. Since its creation in 1951, then as the JEN, and since 1986 as the CIEMAT, it has been carrying out research and technological development projects, serving as a reference for technical representation of Spain in international forums, and advising government on matters within its scope. CIEMAT is technically and geographically diversifying to better care for the R&D needs of Spain in general and its Autonomous Regions in particular. CIEMAT activities are organised around research projects that span the bridge between R&D and the interests of society. The CIEMAT team is made up of approximately 1200 people, of whom 47% are university graduates. The sphere of CIEMAT collaboration extends from universities to business and is framed by the National Plan for Scientific Research, Development and Technological Innovation. European Union programmes, both in R&D Framework Programmes and the EURATOM treaty, are currently, by number and income generated, the reference with the greatest weight. ENRESA and Nuclear Safety Council R&D programmes constitute another of the basic elements of outside collaboration. CIEMAT presence is relevant in the power production sector, and also collaborates with the rest of industry in those fields that coincide with its own activities.

6. CANARY ASTROPHYSICAL INSTITUTE (IAC)

The Instituto de Astrofísica de Canarias (IAC) is an internationalized Spanish research centre. It has two headquarters and two observatories set in an environment of excellent astronomical quality, both constituting the European Northern Observatory (ENO) . The Instituto de Astrofísica is the main headquarters and normal workplace of the greater part of its staff. Here, astrophysical research and technical projects are developed. There is also a postgraduate school. The IAC also considers scientific outreach as one of its principal aims. The IAC's other headquarters is the Centre for Astrophysics, which is located on La Palma and also houses the offices of the Gran Telescopio CANARIAS and the Magic Collaboration, as well as the supercomputer La Palma.

B. REGIONAL GEOSCIENCE RESEARCH CENTERS

Autonomic Governments have also created their own research centres in the field of geosciences, a list of those is included below:

ANDALUCIA

- ANDALUSIAN CENTER FOR THE ASSESMENT AND MONITORING OF GLOBAL CHANGE
- ANDALUSIAN CENTER OF MARINE SCIENCE AND TECHNOLOGIES
- ANDALUSIAN ENVIRONMENT CENTER
- UNIVERSITARY INSTITUTE FOR WATER (GRANADA)
- ANDALUSIAN INSTITUTE OF EARTH SCIENCES
- ANDALUSIAN GEOPHYSICAL INSTITUTE

ASTURIAS

- INSTITUTE OF NATURAL RESOURCES AND LAND-USE PLANNING

BASQUE COUNTRY

- BASQUE ENERGY AGENCY

CASTILLE-LA MANCHA

- UNIVERSITARY INSTITUTE OF ENVIRONMENTAL SCIENCES

CASTILLE-LEON

- CENTER FOR WATER RESEARCH AND TECHNOLOGICAL DEVELOPMENT
- ENERGY CITY FOUNDATION (LEON)
- PUBLIC SOCIETY OF MINING RESEARCH AND EXPLOITATION OF CASTILLE-LEON (SIEMCALSA)

CATALONIA

- CATALONIAN GEOLOGICAL SURVEY
- CATALONIAN INSTITUTE OF PALAEONTOLOGY
- GEOMODELS INSTITUTE
- ENVIRONMENT INSTITUTE OF THE UNIVERSITY OF GIRONA (IMA-UDG)
- WATER TECHNOLOGICAL CENTRE (BARCELONA)
- INSTITUTE OF GEOMATICS (BARCELONA)

GALICIA

- UNIVERSITY INSTITUTE OF GEOLOGY "ISIDRO PARGA PONDAL"

MADRID

- MATERIALS SCIENCE INSTITUTE NICOLÁS CABRERA

VALENCIA COMMUNITY

- UNIVERSITARY INSTITUTE OF WATER AND ENVIRONMENTAL SCIENCIES (ALICANTE)
- UNIVERSITARY INSTITUTE OF MATERIALS (ALICANTE)
- INSTITUTE OF MATERIALS TECHNOLOGY (VALENCIA)

RIOJA

- RIOJA PALAEONTOLOGICAL HERITAGE FOUNDATION

C. GEOSCIENCE RESEARCH IN UNIVERSITIES

Although geosciences research is carried out in many science faculties and engineering schools in Spain (physics, chemistry, civil engineering, biology, etc) we will only comment here the geosciences research carried out in the 11 Universities in Spain producing graduates in geology. The location of geology faculties is generally related with the traditional places where geology has been a recognized topic in the sciences catalogue or related with the existence of important mineral resources in the region. There is 1 faculty of geology in Madrid, 1 in Barcelona, 1 in Oviedo, and geology is within faculties of sciences in Granada, Salamanca, Madrid, Barcelona and the Basque Country or a simple department in Huelva, Zaragoza or Valencia. Research in geosciences in this high education centres is carried out within research groups, which cover all earth sciences disciplines. Follows a list of the main geosciences high education centres existing today in Spain

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- FACULTY OF GEOLOGY OF MADRID. COMPLUTENSE UNIVERSITY OF MADRID
- FACULTY OF GEOLOGY OF BARCELONA. UNIVERSITY OF BARCELONA
- FACULTY OF GEOLOGY OF OVIEDO. UNIVERSITY OF OVIEDO
- DPT OF STRATIGRAPHY AND PALEONTOLOGY. FACULTY OF SCIENCES OF GRANADA. UNIVERSITY OF GRANADA
- DPT OF GEOLOGY. FACULTY OF SCIENCES OF SALAMANCA. UNIVERSITY OF SALAMANCA
- DPT OF GEOLOGY AND GEOCHEMISTRY. FACULTY OF SCIENCES. AUTONOMOUS UNIVERSITY OF MADRID.
- DPT OF GEOGRAPHY. FACULTY OF GEOGRAPHY AND HISTORY. UNIVERSITY OF SALAMANCA.
- DPT OF STRATIGRAPHY AND PALEONTOLOGY. DPT OF GEODINAMICS. DPT OF MINERALOGY AND PETROLOGY. FACULTY OF SCIENCES AND TECHNOLOGY. UNIVERSITY OF THE BASQUE COUNTRY
- DPT OF GEOLOGY. DPT OF GEODINAMICS AND PALAEONTOLOGY. UNIVERSITY OF HUELVA
- DPT OF EARTH SCIENCES. UNIVERSITY OF ZARAGOZA
- DPT OF GEOLOGY. UNIVERSITY OF VALENCIA

D. OHER GEOSCIENCES INSTITUTIONS

- GEOLOGICAL SOCIETY OF SPAIN
- SPANISH ASSOCIATION FOR THE EDUCATION IN EARTH SCIENCES

SAN SEBASTIÁN
THE PERFECT SETTING
FOR 36TH IGC

San Sebastian is a traditional and well-known destination for tourist and conventions.
Mountain meets sea in a city built around the lovely "La Concha" bay creating a unique, almost perfect natural landscape.
Tradition and innovation sit harmoniously side by side in a welcoming city, an example of innovation & sustainability.

Human Scale

A cosmopolitan city built to human scale, to enjoy by foot or bycicle.
The quality of life of a big city with the feel of a small, friendly place.

Action-Packed Cultural Life

The city offers a full cultural programme throughout the year, with shows, exhibitions and festivals. San Sebastian is an indisputable reference on the international culture stage.

- One of the most beautiful places in the world
- A well-known tourist destination for a long time
- A prime location and gateway to Europe
- Easy access, convenience and short distances
- Unique structures that cater for every type of need
- Modern and multi-functional hotel facilities

Location

Open to ocean and open to the world. Excellent National & International connections
AIRPORTS:
San Sebastian - 20' away by motorway (Madrid-Barcelona)
Bilbao – 60' away by motorway (Dusseldorf, Frankfurt, Munich, Stuttgart, Brussels, Paris, Lisbon, London…)
Biarritz – 30' away by motorway (Geneve, Helsinki, Paris, Nice, Lyon, Clermont-Ferrand, Dublin, Shannon, London, Briston, Birmingham…)

Accommodation

Quality and comfort rest in friendly, welcoming establishments.
Hotel capacity in San Sebastian 2011 and within 20 km. radius

HOTELS
5* - 260 beds – 136 rooms
4* - 2.380 beds – 1.397 rooms
3* - 493 beds – 792 rooms
2* - 308 beds – 278 rooms
1 * - 210 beds – 358 rooms
Hotel-Apto.– 56 beds – 12 rooms

GUEST HOUSES
2* - 609 beds – 314 rooms
1* - 482 beds – 254 rooms

RURAL HOUSES – 118 beds – 53 rooms
STUDENT ACCOMMODATION – 592 beds

Food capital

San Sebastian has been awarded more Michelin stars per square meter than any other place in the world. Quality and quantity, a recipe for success. Amazing price-quality relation.
Wide variety of restaurants and bars within walking distance. The global density of establishments devoted to gastronomy is one of the highest in the world. Basque specialities, pintxos, cider cellars,…

Leisure

Golf, Thalassotherapy, racecourse, nature, casino, water-related activities… and endless offer.

Surroundings

COAST:
Attractive beaches, monumental towns, spectacular cliffs, Geological Formations…
INTERIOR:
Intense green, natural parks, museums, historical and monumental heritage, traditions, wine cellars, Guggenheim, Oñati.

Kursaal Congress Centre

The innovative and versatile award-winning **KURSAAL is located in the heart of the city**, overlooking the sea and next to one of the 3 beaches San Sebastian has. Considered to be one of the most beautiful cities in Spain, it is located in the northeast of Spain, close to the French border

Most emblematic places of this city are easily accessible on foot from the Congress Center: the Old Town and La Concha Bay, as well as the commercial areas and hotels.

The building has been awarded with the one of the most prestigious European prizes: the **Mies van der Rohe Prize for Contemporary Architecture**.

Meeting & Exhibition space

Meeting rooms

The main auditorium has 1,806 seats, which can be reduced to 1,148 if necessary. A second auditorium with 624 seats is also available. In all, a plenary for 2,430 people is possible.

The meeting rooms are multipurpose areas and multifunctional spaces. These modular rooms can be divided into 20 different rooms with capacity from 10 to 575 people.

Exhibition Space

Indoor: 1,200 sqm are available on the ground floor and 1,300 sqm on the 1st one.
5,000 additional sqm of terraces are also available outdoor.
Poster area: 2 areas of 1,100sqm and 960sqm are available for this purpose.
An enlargement will be carried out and it will be over by 2024.

Auditorium 1 – 1.806 seats
Auditorium 2 – 624 seats

Guarantee for success to host the 36th IGC

- Avant-garde innovative building
- Facing the sea
- City center location
- Integral service concept
- First rate catering services
- Cutting- edge technology
- Highest management quality standards (EFQM)
- Expert human team at your service
- Strong commitment to environmental responsibility (ISO 14,001)
- Committed to providing an accessible environment for all delegates (ISO 17.001)

COMPLEMENTARY VENUES

María Cristina Hotel
Capacity: 250 (400m)

Victoria Eugenia Theatre
Capacity: 900 (220m)

Kursaal

LETTERS OF SUPPORT

MINISTERIO
DE CIENCIA
E INNOVACIÓN

Instituto Geológico
y Minero de España

ROSA DE VIDANIA MUÑOZ
DIRECTORA

Madrid, October 31st, 2011

Prof. Alberto C. Riccardi
Presidente de la Unión Internacional de Ciencias Geológicas (IUGS)
Facultad de Ciencias Naturales y Museo
Universidad Nacional de La Plata
Paseo del Bosque s/n
1900 La Plata - Argentina

Dear Prof. Riccardi,

As the director of the Geological Survey of Spain I am concerned about the proposal of the organization of the 36th International Congress (2020) in Spain. It is my pleasure to offer total support and collaboration to host this Congress. We are doing our best to build up a project where many Spanish geoscience researchers are involved.

In the attached outline of proposal, you can find our ideas and information concerning the proposed organization of the 36th IGC. It is our main goal to prepare a complete final bid for April 2012. For that purpose, we are pleased to receive ideas and suggestions.

With kind regards,

MINISTERIO DE CIENCIA E INNOVACIÓN · Instituto Geológico y Minero de España ·

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Donostiako Udala
Ayuntamiento de San Sebastián

Juan Karlos Izagirre
Donostiako alkatea

Ijentea, 1 - Tel. 943481027 - Faxa 943481720 - www.donostia.org
20003 Donostia-San Sebastián

INSTITUTO GEOLÓGICO Y MINERO DE ESPAÑA
Ríos Rosas, 23
28003 Madrid
Mrs. Rosa de Vidania Muñoz

Donostia-San Sebastián, 21st october 2011

Dear Mrs. de Vidania,

I have been pleased to learn through the San Sebastian Convention Bureau that San Sebastian is going to be presented as a candidate to host the **INTERNATIONAL GEOLOGICAL CONGRESS – IGC** in 2020.

As Mayor of this city, I would like to offer you all my support and assistance, as I hope that the decision will be in favour of San Sebastian and that the city will provide the setting for such an important event.

With the Kursaal Convention Centre right by the beach, the participants will be able to combine the convenience of working in its numerous rooms and services with our city's traditional assets: its coast, gastronomy, culture, shopping and people.

I am sure that the San Sebastian Tourism&Convention Bureau and all professionals involved will guarantee the complete success of your event.

Yours sincerely,

JUAN KARLOS IZAGUIRRE
Mayor of Donostia - San Sebastián

EUSKO JAURLARITZA GOBIERNO VASCO

INDUSTRIA, BERRIKUNTZA, MERKATARITZA ETA TURISMO SAILA
Industria eta Energia Sailburuordetza
Energia eta Meatzegien Zuzendaritza

DEPARTAMENTO DE INDUSTRIA, INNOVACIÓN, COMERCIO Y TURISMO
Viceconsejería de Industria y Energía
Dirección de Energía y Minas

INSTITUTO GEOLÓGICO Y MINERO DE ESPAÑA
Ríos Rosas, 23
28003 Madrid
Att.: Rosa de Vidania Muñoz

Vitoria-Gasteiz, 21th October 2011

Dear Mrs de Vidania,

San Sebastian Convention Bureau has recently informed me of the interest of your organization in the city of San Sebastian as a candidate to host the **INTERNATIONAL GEOLOGICAL CONGRESS–IGC** in 2020.

As Director of Energy and Mines of the Basque Government I am glad to know that San Sebastian can be the elected city for the celebration of an international congress that will attract scientists from all over the world to our region.

By means of this letter I want to express my sincere support and assistance to your organization with this candidature.

I am sure that the city of San Sebastian with its beauty, cosmopolitan character and human scale, along with the Gipuzkoa region famous for its gastronomic culture, landscape and coast, will contribute to the success of your meeting.

Yours sincerely,

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JORGE LETAMENDIA
Director of Energy and Mines
Gobierno Vasco

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