

## SOLICITUD DE BUQUE OCEANOGRÁFICO PLAN DE CAMPAÑA

Es obligatorio cumplimentar todos los apartados.

Recuerde que la información que se incorpore en este documento servirá para valorar la viabilidad de la campaña y en su caso del proyecto. En caso de estar incompleta podrá suponer la no financiación del proyecto (Anexo IV punto 5 de la convocatoria).

### 1. DATOS DEL IP (AÑADIR EN CASO DE MÁS DE UN IP):

|                    |                                                          |           |           |
|--------------------|----------------------------------------------------------|-----------|-----------|
| Nombre:            | DAVID CASAS LAYOLA                                       |           |           |
| Organismo          | CSIC                                                     |           |           |
| Centro:            | INSTITUTO DE CIENCIAS DEL MAR                            |           |           |
| Dirección          | PASSEIG MARÍTIM DE LA BARCELONETA 37-49. 08003 BARCELONA |           |           |
| Correo electrónico | davidcasas@icm.csic.es                                   | Teléfono: | 932309500 |

#### IP 2

|                    |                                                                        |           |           |
|--------------------|------------------------------------------------------------------------|-----------|-----------|
| Nombre:            | NIEVES MARÍA LÓPEZ GONZÁLEZ                                            |           |           |
| Organismo          | CENTRO NACIONAL INSTITUTO ESPAÑOL DE OCEANOGRAFÍA (IEO, CSIC)          |           |           |
| Centro:            | CENTRO OCEANOGRÁFICO DE MÁLAGA                                         |           |           |
| Dirección          | PUERTO PESQUERO, S/N. 29640 FUENGIROLA (MÁLAGA)                        |           |           |
| Correo electrónico | <a href="mailto:nieves.lopez@ieo.csic.es">nieves.lopez@ieo.csic.es</a> | Teléfono: | 952197124 |

### 2. DATOS DEL PROYECTO:

- Título el proyecto:

**Integrated approach for developing a quantitative submarine landslide hazard. Failure (susceptibility) analysis in SW Mediterranean Sea. inGRAVITAS**

### 3. PLAN DE CAMPAÑA:

- Documento de formato libre en el que se describirá con suficiente detalle el plan de campaña, adjuntando uno o varios mapas detallados, así como todas las coordenadas de aquellos lugares en que se desarrolle la labor. A modo de índice, recogerá obligatoriamente los siguientes puntos:
  - Acrónimo de la campaña.  
**inGRAVITAS-1**
  - Jefe/a de campaña previsto.  
David Casas (ICM-CSIC). Co-jefes: Nieves López-González (IEO-CSIC); Ferran Estrada (ICM-CSIC).

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- Duración máxima y mínima de la campaña debidamente justificados.

28 operating days are required. This duration is justified by the area covered and the kilometres of geophysics (4070 km) and seismic acquisition (2100 km) planned. Each equipment has, for an optimal resolution, minimum requirements regarding velocity or sea conditions that have been considered. Logistical aspects (deploy, recovery, transits, breakdowns, etc.) have also been accounted because based on the experience of the team, are important time-consuming points.

- En su caso, justificación de requerimientos de temporalidad.

Thanks to the detailed knowledge of the area and its meta-oceanic conditions, the navigation should avoid the winter period. This is specially important to avoid bad weather conditions during deploy and recovery gears such as airguns or piston corer that may exceed the tolerance of the manoeuvres. It is also important to get a good quality geophysical records.

- Objetivos de la campaña.

The **main objective** of the **inGRAVITAS** is the **submarine landslide hazard analysis and quantification** through the study of the slope characteristics and triggering factors (e.g. sources) in an extent of the southern Iberian margin bounded by Palomares and adjacent areas of Alboran continental margins.

Acquisition during inGRAVITAS-1 will be specially addressed to specific objective 1 (**Geology and Geomorphology**) in order to complete the sedimentary, stratigraphic and geomorphological characterization of the study area. The cruise plan is designed to fulfil the gaps of incomplete, inaccurate or totally absent data needed to fully understand the instability processes in the area (Fig. 1).

The cruise is aimed to increase the detail and resolution (i.e. geophysics and seismic acquisition) of the regional geodynamic and stratigraphic contexts to understand the distribution and characteristics of tectonic structures and mass movements as well as their links with the Quaternary evolution of the margin. The salt tectonics present in the distal Palomares continental margin is distinctive in the cruise plan because is scarcely studied. Salt diapirs create specific geo-environmental conditions that affect the stability of the whole margin and their role have to be considered at regional level. Additionally, during inGRAVITAS-1 some sediment cores are planned to be recovered in distal areas.

In summary the plan designed entails different activities onboard:

1. Parametric profiles and multibeam data (simultaneous acquisition).
2. Multichannel seismic (airguns) acquisition. Seismic grid is less dense than geophysical grid but will be also simultaneous. Air-guns are the limiting factor in terms of navigation speed. When the equipment is deployed the velocity will be limited to 4- 4.5 knots.
3. Continuous acquisition of gravimeter and ADCP.
4. Sediment cores recovery (Piston corer) in defined sites. When seismic and geophysical

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acquisition stops.

- Mapa general y de detalle de las zonas de muestreo.

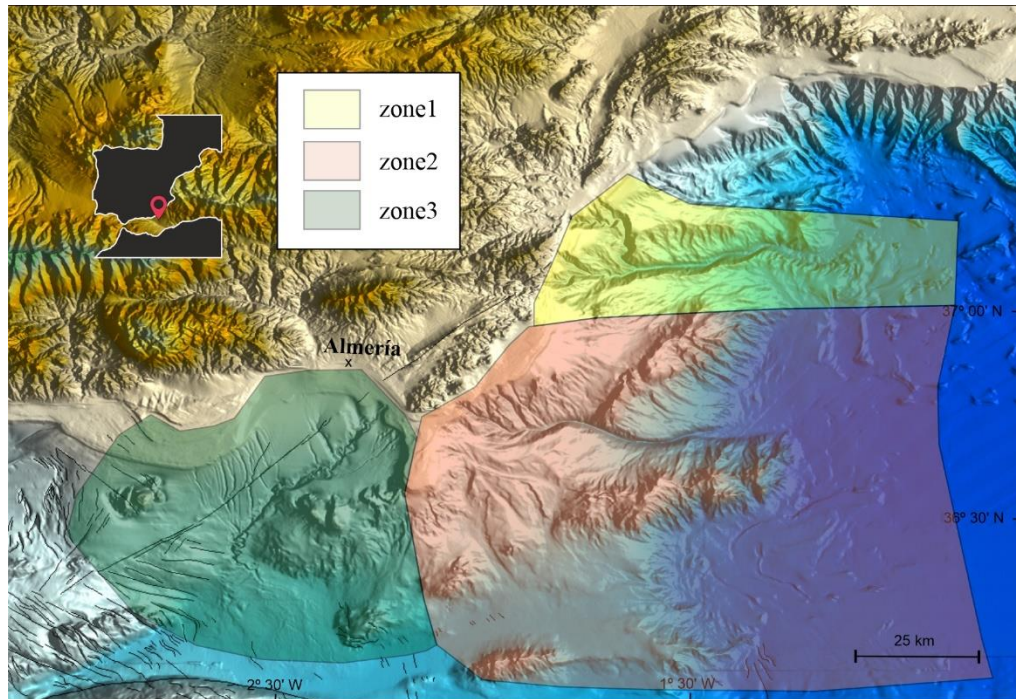
The working area of the project is approximately limited by the coordinates 36° 22' 34.8095" N/ 3° 00' 25.2115" W and 37° 08' 39.4738" N/ 0° 50' 15.4044" W, covering partially the Gulf of Vera and the adjacent Alboran Sea (Fig. 1). There, three zones (zone 1, 2 and 3) are defined to delimit the different needs of acquisition (during inGRAVITAS-1 and 2 cruises). Zones do not mean a compartmentalization in objectives or expected results.

**Zone 1** is the northern part of the working area and comprises the Almanzora-Alías-Garrucha (AAG) canyon and its margins. This area was mainly surveyed by the FAUCES project, therefore, the inGRAVITAS team has available data of seismic and geophysical records, ROV images, CPTu tests and sediment cores. In this area, regional seismic lines to cover the distal part of the margin that guarantee the correlation with other areas is the only acquisition target.

**Zone 2** covers the southern part of the Palomares margin, from AAG to Cabo de Gata. Is the area where inGRAVITAS project will concentrate a greater effort of data acquisition because it is where there is less data availability. Here geophysical (parametric profiles and bathymetry), seismic profiles, sediment cores and CPTu data are expected to be obtained.

**Zone 3** includes the Gulf of Almeria and adjacent areas of Alboran sea. There is an important collection of seismic profiles available here. Major efforts here will be for sediment cores and *in situ* geotechnical tests (planned during inGRAVITAS-2 cruise) but regarding seismic acquisition of inGRAVITAS-1 cruise, it will be focussed on cover the gaps that guarantee the correlation with previous data and a new processing to improve the current profiles resolution. New profiles recorded with a long streamer are needed on the upper continental slope of the Gulf of Almería to perform a processing that allow to remove the multiples and therefore to access a hidden/messy record dominated by mass movements.

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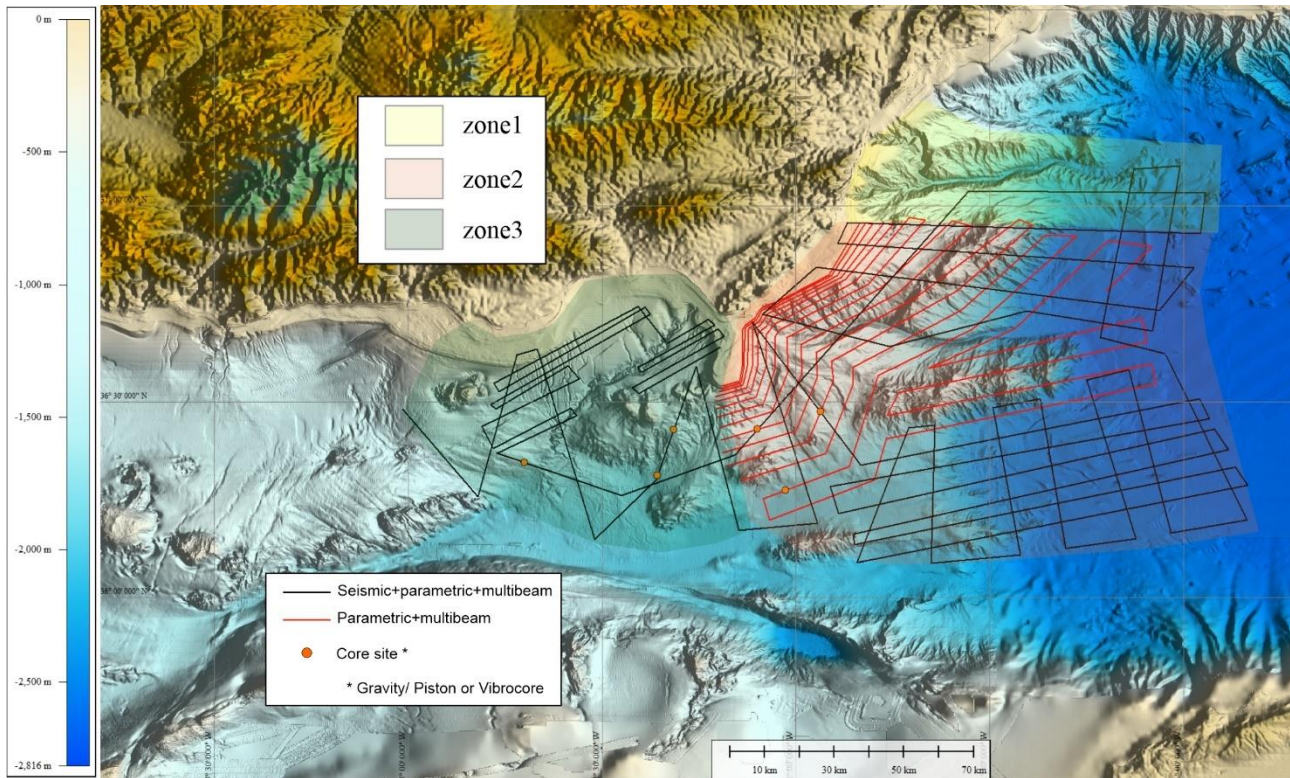
**Fig. 1.** General Map of the southern Iberian margins and study areas of the inGRAVITAS project bounded by Palomares and adjacent areas of Alboran continental margins. Three areas (1, 2 and 3) are proposed to acquire data with different density and distribution considering the available data and gaps to be covered.

Acquisition and sampling will be performed from the external shelf/shelf break to the distal margin, from about 100 to up to 2600-meter water depth (mwd). Continental shelf is not an acquisition priority due to the availability of high-resolution bathymetry offered by the Secretaría General de Pesca (Ministerio de Agricultura, Pesca y Alimentación) in open access from its website.

The acoustic, seismic and geophysical grids (Fig. 2) are defined following geostructural, sedimentary and morphological criteria. Sampling sites (piston cores) are very preliminary, definitive position should be decided during the cruise with the help of the results obtained from parametric profiles. The main activity of sampling (cores and CPTu tests) will be concentrated in inGRAVITAS-2 cruise.



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**Fig. 2.** Cruise plan of inGRAVITAS-1. Different densities of seismic lines (black lines) and parametric and bathymetry lines (red lines) are planned through the zones 1, 2 and 3. The possible location of sediment cores are also indicated.

- Tabla con coordenadas de las estaciones o del principio y final de las líneas o lances. Incluirá la profundidad de las estaciones o cualquier otro detalle de referencia. En el caso de campañas en las que los puntos de muestreo no se puedan definir a priori, descripción detallada de la zona de trabajo, así como del tipo de maniobras y operaciones previstas.

| MULTIBEAM & AIRGUN-SEISMIC & TOPAS LINES IN ZONES 1 AND 2 |            |            |             |         |            |            |             |
|-----------------------------------------------------------|------------|------------|-------------|---------|------------|------------|-------------|
| LINE ID                                                   | Longitude  | Latitude   | Length (km) | LINE ID | Longitude  | Latitude   | Length (km) |
| 1                                                         | -1.8326191 | 36.3372972 | 48          | 24      | -0.9592658 | 36.5081686 | 6           |
| 2                                                         | -2.1134146 | 36.7037194 | 59          | 25      | -0.9340699 | 36.4570674 | 90          |
| 3                                                         | -1.9452927 | 36.1903318 | 18          | 26      | -1.9121429 | 36.2834741 | 8           |
| 4                                                         | -2.1474334 | 36.171656  | 47          | 27      | -1.890132  | 36.2142742 | 90          |
| 5                                                         | -2.2570054 | 36.5889261 |             | 28      | -0.9208075 | 36.4297493 | 7           |
| 6                                                         | -1.0494445 | 36.6229695 | 16          | 29      | -0.8849646 | 36.377575  | 90          |
| 7                                                         | -1.2155323 | 36.6630839 | 48          | 30      | -1.8529008 | 36.1613949 | 3           |
| 8                                                         | -1.1286027 | 37.0932622 | 11          | 31      | -1.8493086 | 36.1358271 | 91          |

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|    |            |            |    |    |            |            |    |
|----|------------|------------|----|----|------------|------------|----|
| 9  | -1.0106415 | 37.098229  | 47 | 32 | -0.8664288 | 36.3327161 | 6  |
| 10 | -1.0805359 | 36.6799015 | 30 | 33 | -0.8356724 | 36.2865619 | 93 |
| 11 | -1.4050515 | 36.7305662 | 33 | 34 | -1.8420245 | 36.0898932 | 40 |
| 12 | -1.7593148 | 36.6408732 | 31 | 35 | -1.7092512 | 36.4338379 | 6  |
| 13 | -2.0867092 | 36.7222734 | 18 | 36 | -1.6422186 | 36.4403433 | 39 |
| 14 | -1.9488063 | 36.8423848 | 80 | 37 | -1.6520449 | 36.0874098 | 21 |
| 15 | -1.0620955 | 36.7336142 | 14 | 38 | -1.4219574 | 36.1094883 | 42 |
| 16 | -0.9739477 | 36.8406681 | 82 | 39 | -1.4929601 | 36.4848862 | 11 |
| 17 | -1.8925335 | 36.9035275 | 6  | 40 | -1.3703355 | 36.5072733 | 43 |
| 18 | -1.8672243 | 36.9564501 | 81 | 41 | -1.3047995 | 36.1258534 | 17 |
| 19 | -0.9578501 | 36.9287665 | 12 | 42 | -1.123082  | 36.1507363 | 46 |
| 20 | -0.9436883 | 37.0318159 | 54 | 43 | -1.2499899 | 36.5547408 | 10 |
| 21 | -1.5550774 | 37.0380253 | 92 | 44 | -1.1417665 | 36.5819984 | 47 |
| 22 | -2.1570759 | 36.3649531 |    | 45 | -1.0336798 | 36.164395  | 18 |
| 23 | -1.8326191 | 36.3372972 | 81 | 46 | -0.8372164 | 36.1986745 | 50 |
| 24 | -0.9592658 | 36.5081686 | 6  | 47 | -1.0457195 | 36.6192444 |    |

### MULTIBEAM & TOPAS LINES IN ZONES 1 AND 2

| LINE ID | Longitude  | Latitude   | Length (km) | LINE ID | Longitude  | Latitude   | Length (km) |
|---------|------------|------------|-------------|---------|------------|------------|-------------|
| 1       | -2.1905837 | 36.5398851 | 4.2         | 77      | -2.085426  | 36.4943448 | 10.1        |
| 2       | -2.1456522 | 36.5513512 | 4.1         | 78      | -2.0544398 | 36.5819335 | 9.4         |
| 3       | -2.1397139 | 36.5875752 | 10.9        | 79      | -2.0537356 | 36.6665292 | 2.2         |
| 4       | -2.1367447 | 36.6855584 | 1.2         | 80      | -2.0424679 | 36.684311  | 19.6        |
| 5       | -2.1308063 | 36.6956536 | 3           | 81      | -1.858382  | 36.781027  | 14.2        |
| 6       | -2.1058652 | 36.7134687 | 2.3         | 82      | -1.7897588 | 36.8964364 | 1.9         |
| 7       | -2.0951761 | 36.7324715 | 1.4         | 83      | -1.768612  | 36.8952018 | 15.8        |
| 8       | -2.0850809 | 36.7419729 | 3.5         | 84      | -1.8385149 | 36.7641032 | 20          |
| 9       | -2.0494506 | 36.7544435 | 4.1         | 85      | -2.0238498 | 36.6633161 | 9.4         |
| 10      | -2.0108512 | 36.7746339 | 10.1        | 86      | -2.0211209 | 36.5787645 | 12.1        |
| 11      | -1.9152435 | 36.8233286 | 9.9         | 87      | -2.06113   | 36.4748465 | 13.2        |
| 12      | -1.856697  | 36.8989865 | 0.7         | 88      | -2.198411  | 36.4329667 | 3.4         |
| 13      | -1.8493657 | 36.8973927 | 9.7         | 89      | -2.1936647 | 36.4026078 | 15.1        |
| 14      | -1.9072249 | 36.8238252 | 6.9         | 90      | -2.0344206 | 36.4478986 | 14.8        |
| 15      | -1.9723223 | 36.7909381 | 4.5         | 91      | -1.9848604 | 36.5749242 | 7.9         |
| 16      | -2.0150456 | 36.7692243 | 3.4         | 92      | -1.9880294 | 36.6458314 | 19.4        |
| 17      | -2.0466186 | 36.7526162 | 2.9         | 93      | -1.8133948 | 36.7496729 | 17.6        |
| 18      | -2.0763136 | 36.742757  | 1.5         | 94      | -1.7453314 | 36.8986765 | 1.9         |
| 19      | -2.0881682 | 36.733426  | 1.8         | 95      | -1.7244218 | 36.9007614 | 17.4        |
| 20      | -2.0961495 | 36.7185784 | 1           | 96      | -1.7884382 | 36.7526162 | 2.2         |

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|    |            |            |      |     |            |            |      |
|----|------------|------------|------|-----|------------|------------|------|
| 21 | -2.1016659 | 36.7112427 | 2.6  | 97  | -1.7663636 | 36.7440316 | 18.4 |
| 22 | -2.124436  | 36.6959844 | 0.8  | 98  | -1.701918  | 36.9019469 | 2.4  |
| 23 | -2.1293657 | 36.689705  | 6.8  | 99  | -1.6754285 | 36.9041543 | 16.4 |
| 24 | -2.1317131 | 36.6286717 | 3.8  | 100 | -1.7351985 | 36.7646838 | 2.5  |
| 25 | -2.1317131 | 36.594047  | 4.5  | 101 | -1.7076206 | 36.7691313 | 16.3 |
| 26 | -2.1391075 | 36.5540232 | 0.5  | 102 | -1.6539057 | 36.9093051 | 2.1  |
| 27 | -2.1414549 | 36.5497979 | 4.7  | 103 | -1.6303595 | 36.9118804 | 14.5 |
| 28 | -2.1908679 | 36.5369186 | 1.5  | 104 | -1.677452  | 36.7871589 | 1.3  |
| 29 | -2.1988878 | 36.5254483 | 5.7  | 105 | -1.6634714 | 36.7845835 | 15.3 |
| 30 | -2.1385446 | 36.541526  | 0.7  | 106 | -1.6082849 | 36.9155595 | 2.4  |
| 31 | -2.1349452 | 36.5469251 | 4.8  | 107 | -1.5821632 | 36.9089371 | 13.4 |
| 32 | -2.1250859 | 36.5896093 | 8    | 108 | -1.6399251 | 36.7970924 | 1.5  |
| 33 | -2.1231298 | 36.6615973 | 2.5  | 109 | -1.6226334 | 36.7967245 | 12.1 |
| 34 | -2.1232862 | 36.6836827 | 0.8  | 110 | -1.5641356 | 36.8953245 | 2.6  |
| 35 | -2.1190609 | 36.6897665 | 1.9  | 111 | -1.5387498 | 36.8842872 | 12.3 |
| 36 | -2.1019246 | 36.7002908 | 0.7  | 112 | -1.6145919 | 36.7917052 | 7.8  |
| 37 | -2.0965255 | 36.7052595 | 1.2  | 113 | -1.6941453 | 36.7636635 | 27.4 |
| 38 | -2.0894049 | 36.7143363 | 1.2  | 114 | -1.9486586 | 36.6264045 | 7    |
| 39 | -2.0845536 | 36.7244498 | 0.6  | 115 | -1.9454895 | 36.5638161 | 16.2 |
| 40 | -2.079937  | 36.7286948 | 0.9  | 116 | -2.0011457 | 36.4247746 | 18   |
| 41 | -2.0729338 | 36.7346123 | 2.1  | 117 | -2.1893073 | 36.3685242 | 3.9  |
| 42 | -2.0507896 | 36.7420458 | 10.9 | 118 | -2.1809886 | 36.3340279 | 20.2 |
| 43 | -1.9472286 | 36.7945794 | 5    | 119 | -1.9695874 | 36.3967154 | 18.4 |
| 44 | -1.9013225 | 36.8208919 | 9.9  | 120 | -1.9036978 | 36.5541439 | 5.4  |
| 45 | -1.8423531 | 36.8961177 | 0.7  | 121 | -1.9079232 | 36.6030659 | 28.2 |
| 46 | -1.8350218 | 36.8948427 | 10.7 | 122 | -1.6485243 | 36.7480659 | 7.1  |
| 47 | -1.89689   | 36.8121768 | 3.3  | 123 | -1.5825688 | 36.7843117 | 24.2 |
| 48 | -1.9270402 | 36.7951747 | 8.6  | 124 | -1.42318   | 36.9613644 | 3.3  |
| 49 | -2.0086135 | 36.753273  | 4    | 125 | -1.3861437 | 36.9578079 | 30   |
| 50 | -2.0462898 | 36.733848  | 2    | 126 | -1.5753538 | 36.7339468 | 29.7 |
| 51 | -2.0667125 | 36.7271578 | 1.2  | 127 | -1.8534368 | 36.5883692 | 4.7  |
| 52 | -2.0769239 | 36.7208197 | 1.7  | 128 | -1.8534368 | 36.5458843 | 20.6 |
| 53 | -2.0836141 | 36.7061483 | 1.6  | 129 | -1.9241459 | 36.3688143 | 21.3 |
| 54 | -2.0938254 | 36.694059  | 1.6  | 130 | -2.1451862 | 36.2992936 | 7.5  |
| 55 | -2.108157  | 36.6856363 | 0.4  | 131 | -2.0845504 | 36.2525009 | 21.9 |
| 56 | -2.1117833 | 36.68285   | 10.3 | 132 | -1.8624852 | 36.3341032 | 26.6 |
| 57 | -2.1133091 | 36.5897155 | 6.1  | 133 | -1.7886834 | 36.5661848 | 25.6 |
| 58 | -2.1278632 | 36.5361353 | 7.6  | 134 | -1.5441026 | 36.6859294 | 38.4 |
| 59 | -2.2076026 | 36.5127722 | 1.7  | 135 | -1.3168387 | 36.9799285 | 8.3  |
| 60 | -2.2138967 | 36.4978566 | 9.3  | 136 | -1.2316215 | 37.0099592 | 47.1 |

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|    |            |            |      |     |            |            |      |
|----|------------|------------|------|-----|------------|------------|------|
| 61 | -2.1156859 | 36.5260853 | 7    | 137 | -1.5100835 | 36.6492002 | 12.4 |
| 62 | -2.0989604 | 36.5874414 | 9.7  | 138 | -1.626803  | 36.588771  | 17.3 |
| 63 | -2.0980801 | 36.6752942 | 2.7  | 139 | -1.4428249 | 36.6363693 | 44.3 |
| 64 | -2.0760729 | 36.6921957 | 2.7  | 140 | -1.1958933 | 36.9829588 | 5.7  |
| 65 | -2.0632207 | 36.7143789 | 2.3  | 141 | -1.133119  | 36.9721189 | 40.1 |
| 66 | -2.0408614 | 36.7241501 | 16.5 | 142 | -1.3488698 | 36.6556156 | 22.5 |
| 67 | -1.8863432 | 36.8062902 | 11.1 | 143 | -1.1065121 | 36.7111475 | 6.6  |
| 68 | -1.8237985 | 36.8928717 | 1.1  | 144 | -1.09628   | 36.6521695 | 58.8 |
| 69 | -1.8112895 | 36.8933623 | 11.6 | 145 | -1.734157  | 36.5240658 | 7.2  |
| 70 | -1.8704004 | 36.7999131 | 19.9 | 146 | -1.7650233 | 36.4638669 | 62.8 |
| 71 | -2.0545282 | 36.698931  | 3.6  | 147 | -1.0830516 | 36.5969552 | 5.9  |
| 72 | -2.0765131 | 36.671839  | 9.4  | 148 | -1.0703983 | 36.5451919 | 64.3 |
| 73 | -2.0783617 | 36.5870673 | 8.6  | 149 | -1.7662695 | 36.4050101 | 12   |
| 74 | -2.1034499 | 36.5118027 | 9.9  | 150 | -1.798811  | 36.2998421 | 26.6 |
| 75 | -2.2071258 | 36.4810305 | 2.4  | 151 | -2.0677715 | 36.1988426 | ---  |
| 76 | -2.2039568 | 36.4593754 | 11.3 |     |            |            |      |

| MULTIBEAM & AIRGUN-SEISMIC & TOPAS LINES IN ZONE 3 |            |            |             |         |            |            |             |
|----------------------------------------------------|------------|------------|-------------|---------|------------|------------|-------------|
| LINE ID                                            | Longitude  | Latitude   | Length (km) | LINE ID | Longitude  | Latitude   | Length (km) |
| 1                                                  | -2.2570054 | 36.5889261 | 33.5        | 20      | -2.5582324 | 36.5591775 | 26.4        |
| 2                                                  | -2.36159   | 36.2994788 | 22.0        | 21      | -2.8099329 | 36.436046  | 6.6         |
| 3                                                  | -2.5192745 | 36.1481876 | 55.6        | 22      | -2.7809288 | 36.3810202 | 21.2        |
| 4                                                  | -2.6667896 | 36.6349148 | 5.1         | 23      | -2.5819643 | 36.4833884 | 2.5         |
| 5                                                  | -2.7205186 | 36.6192978 | 41.2        | 24      | -2.5650762 | 36.4652167 | 21.6        |
| 6                                                  | -2.8201756 | 36.2570269 | 30.3        | 25      | -2.7731986 | 36.3672537 | ---         |
| 7                                                  | -3.0137197 | 36.4805113 | ---         | 26      | -2.1948127 | 36.6389426 | 23.0        |
| 8                                                  | -2.7722064 | 36.3686141 | 31.331      | 27      | -2.4054361 | 36.5205868 | 2.2         |
| 9                                                  | -2.4497179 | 36.2608745 | 28.707      | 28      | -2.4218905 | 36.5355448 | 25.8        |
| 10                                                 | -2.1570759 | 36.3649531 | ---         | 29      | -2.1844033 | 36.6670361 | 2.5         |
| 11                                                 | -2.3343692 | 36.651929  | 12.0        | 30      | -2.2018966 | 36.6843833 | 21.4        |
| 12                                                 | -2.4065065 | 36.7433757 | 39.8        | 31      | -2.3991586 | 36.575297  | 1.6         |
| 13                                                 | -2.7795869 | 36.5471624 | 2.7         | 32      | -2.409302  | 36.587047  | 21.5        |
| 14                                                 | -2.7659455 | 36.5256273 | 41.3        | 33      | -2.2101354 | 36.6953944 | 2.2         |
| 15                                                 | -2.3888048 | 36.7405935 | 2.2         | 34      | -2.226359  | 36.7102329 | 11.6        |
| 16                                                 | -2.3755199 | 36.7236963 | 44.9        | 35      | -2.3314183 | 36.6492583 | ---         |
| 17                                                 | -2.7874429 | 36.4928107 | 1.7         |         |            |            |             |
| 18                                                 | -2.7744939 | 36.4814072 | 20.7        |         |            |            |             |
| 19                                                 | -2.5873482 | 36.5908238 | 4.4         |         |            |            |             |



## SOLICITUD DE BUQUE OCEANOGRÁFICO PLAN DE CAMPAÑA

Sediment sampling of inGRAVITAS-1 will be performed in deep areas at sites to be determined after the TOPAS records are available to guarantee a proper sedimentary record. Preliminary sites are between 1350- and 1900-meters water depth (mwd) in the distal parts of zones 2 and 3:

| LONG          | LAT           | Depth (mwd) |
|---------------|---------------|-------------|
| -2.7006665456 | 36.3448140003 | 1350        |
| -2.3570593774 | 36.3120670067 | 1690        |
| -1.7842958807 | 36.3467525417 | 1880        |
| -2.0273017147 | 36.2735390638 | 1900        |

- Requerimiento detallado de apoyo por parte de la tripulación para las maniobras de cubierta. En el caso de fondeos u otras maniobras no habituales, aportar el máximo detalle sobre la instrumentación y sobre la propuesta de maniobra.

Not special support is expected. The help required from the crew is the common in an average cruise of marine geology for deploy and recovery of seismic and corer equipments.

- Instrumentación del buque o sistemas portátiles que se emplearán, tanto del sistema nacional, como del propio equipo científico, así como los requerimientos del personal técnico necesarios para la campaña.

### *Ship's equipment list requested:*

Atlas Parasound P-35/ TOPAS

Multibeam Atlas Hydrosweep Fansweep 20

Multibeam Atlas Hydrosweep DS-3 1° × 1° (Deep waters)

XBts

Caris software

EA 600 sounder

KongsbergMaritime EK 60

Piston Corer

Gravity Corer, Vibrocorer

ADCP OceanSurveyor 75-150 kHz

Gravímetro Micro-g LaCposte Air-Sea system II

High resolution multichannel seismic system. Air-guns, GeoEel streamer (48 ch), Eiva, Delph.

High resolution multichannel seismic system. Sparker.

All the equipment listed is managed and supported by the UTM-CSIC

- Requerimiento de apoyo técnico para asegurar el desarrollo de la campaña.

## SOLICITUD DE BUQUE OCEANOGRÁFICO PLAN DE CAMPAÑA

The equipment requested for inGRAVITAS-1 cruise has to be linked to the technical support of: 4/5 engineers, 2 seismic 2 electronic-acoustic and 2 for data and communications.

- Personal científico o técnico que embarcará y en su caso, referencia a su responsabilidad en relación con las maniobras o sistemas de buque que se emplearán.

The 24/24h working days needs to be covered by 3 shifts of at least 4 scientists each one. It results in 12-13 people to what must be added Master's and PhD students. Scientific team will cover during shifts the monitoring and quality control of seismic/geophysics acquisition and will process sediment cores for their storage in the best conditions possible.

- Reactivos y materiales peligrosos que se plantea embarcar.

Not applicable

- Incluir el plan de trabajo diario de campaña, con el detalle de las maniobras y operaciones previsto.

| Day   | inGRAVITAS-1 activity                                                        |
|-------|------------------------------------------------------------------------------|
| 1     | Transit to Zone 1. Multibeam calibration and deployment of seismic equipment |
| 2-12  | Multibeam & airgun-seismic & Topas & geophysical Zone 1 and Zone 2           |
| 12-21 | Multibeam mosaic in Zone 2                                                   |
| 22-26 | Multibeam & airgun-seismic & Topas & geophysical Zone 3                      |
| 27-28 | Sediment sampling                                                            |
| 28    | End of work and transit to port                                              |

- Alternativas en caso de mal tiempo, que puedan afectar a los muestreos previstos.

In the case of weather or sea conditions interfere with the normal course of acquisition, the team will adapt the plan avoiding techniques such as towed seismic equipment or corer deployment. Logistical aspects (deploy, recovery, transits, breakdowns, weather) have been accounted based on the experience of the team. The plan can be changed for short periods of time.

- Plan de contingencia para el caso en que la campaña se retrase o se anule y afectación en los objetivos del proyecto en los escenarios alternativos

inGRAVITAS project is based on the acquisition of high-resolution data. The general working plan of the project has been designed to restrain the effects of potential delays in the cruises programming but the cruises are essentials and cannot be cancelled.

## SOLICITUD DE BUQUE OCEANOGRÁFICO PLAN DE CAMPAÑA

El/la IP contemplará que la información del plan de campaña que se incluya en este documento, definirá el contexto máximo de la campaña, en términos de área de trabajo, duración e instrumentación que se pondrá a su disposición en caso de ser aprobado el proyecto.

**NOTA.-** El/la IP y/o jefe/a de campaña serán, en su caso, responsables de la tramitación inicial de los permisos de trabajo en aguas extranjeras o en zonas protegidas.

### 4. RESUMEN DEL PLAN DE CAMPAÑA (máximo 10 líneas).

The **project inGRAVITAS** propose to address the **submarine landslide hazard analysis and quantification** through the study of the slope characteristics and triggering factors (e.g. sources) in an extent of the S Iberian margin. Acquisition during inGRAVITAS-1 will be specially addressed to a sedimentary, stratigraphic and geomorphological characterization of an area approximately limited by the coordinates 36° 22' 34.8095" N/ 3° 00' 25.2115" W and 37° 08' 39.4738" N/ 0° 50' 15.4044" W, covering partially the Gulf of Vera and the adjacent Alboran Sea. The cruise plan is designed to fulfil the gaps of incomplete, inaccurate or totally absent data needed to fully understand the instability processes in the area.



## SOLICITUD DE BUQUE OCEANOGRÁFICO PLAN DE CAMPAÑA

Es obligatorio cumplimentar todos los apartados.

Recuerde que la información que se incorpore en este documento servirá para valorar la viabilidad de la campaña y en su caso del proyecto. En caso de estar incompleta podrá suponer la no financiación del proyecto (Anexo IV punto 5 de la convocatoria).

### 1. DATOS DEL IP (AÑADIR EN CASO DE MÁS DE UN IP):

|                    |                                                          |           |           |
|--------------------|----------------------------------------------------------|-----------|-----------|
| Nombre:            | DAVID CASAS LAYOLA                                       |           |           |
| Organismo          | CSIC                                                     |           |           |
| Centro:            | INSTITUTO DE CIENCIAS DEL MAR                            |           |           |
| Dirección          | PASSEIG MARÍTIM DE LA BARCELONETA 37-49. 08003 BARCELONA |           |           |
| Correo electrónico | davidcasas@icm.csic.es                                   | Teléfono: | 932309500 |

#### IP 2

|                    |                                                                        |           |           |
|--------------------|------------------------------------------------------------------------|-----------|-----------|
| Nombre:            | NIEVES MARÍA LÓPEZ GONZÁLEZ                                            |           |           |
| Organismo          | CENTRO NACIONAL INSTITUTO ESPAÑOL DE OCEANOGRAFÍA (IEO, CSIC)          |           |           |
| Centro:            | CENTRO OCEANOGRÁFICO DE MÁLAGA                                         |           |           |
| Dirección          | PUERTO PESQUERO, S/N. 29640 FUENGIROLA (MÁLAGA)                        |           |           |
| Correo electrónico | <a href="mailto:nieves.lopez@ieo.csic.es">nieves.lopez@ieo.csic.es</a> | Teléfono: | 952197124 |

### 2. DATOS DEL PROYECTO:

- Título el proyecto:

**Integrated approach for developing a quantitative submarine landslide hazard. Failure (susceptibility) analysis in SW Mediterranean Sea. inGRAVITAS**

### 3. PLAN DE CAMPAÑA:

- Documento de formato libre en el que se describirá con suficiente detalle el plan de campaña, adjuntando uno o varios mapas detallados, así como todas las coordenadas de aquellos lugares en que se desarrolle la labor. A modo de índice, recogerá obligatoriamente los siguientes puntos:
  - Acrónimo de la campaña.  
**inGRAVITAS-2**
  - Jefe/a de campaña previsto.  
David Casas (ICM-CSIC). Co-jefes: Nieves López-González (IEO-CSIC); Mariano Yenes (USAL).



## SOLICITUD DE BUQUE OCEANOGRÁFICO PLAN DE CAMPAÑA

- Duración máxima y mínima de la campaña debidamente justificados.

23 operating days are required. This duration is justified by the area covered and the sediment/geotechnical sampling planned. Each equipment has minimum requirements regarding velocity or sea conditions that have been considered. Logistical aspects (deploy, recovery, transits, breakdowns, etc.) have also been accounted because based on the experience of the team, are important time-consuming points. CPTu logistics may also require to plan 2 legs for this cruise (to be confirmed)

- En su caso, justificación de requerimientos de temporalidad.

Thanks to the detailed knowledge of the area and its meta-oceanic conditions, the navigation should avoid the winter period. This is specially important to avoid bad weather conditions during deploy and recovery gears such as CPTu and sediment corer (piston corer and/or vibrocorer) that may exceeds the tolerance of the manoeuvres.

- Objetivos de la campaña.

The **main objective** of the **inGRAVITAS** is the **submarine landslide hazard analysis and quantification** through the study of the slope characteristics and triggering factors (e.g. sources) in an extent of the southern Iberian margin bounded by Palomares and adjacent areas of Alboran continental margins.

Acquisition during inGRAVITAS-2 will be specially addressed to specific objectives 1 (**Geology and Geomorphology**) and 2 (**Geotechnics**). The cruise plan is designed as complementary to inGRAVITAS-1 cruise and will focus on data needed to fully understand the instability processes in the area (Fig. 1). A sedimentary and geotechnical characterization of the study area will be addressed in order to get a good correlation among the different processes and properties of the continental margins involved.

The cruise is aimed to obtain *in situ* geotechnical data along and across the zones 2 and 3 as well as sediment cores to characterise the sedimentary environments and their mechanical characteristics to build geotechnical/stability models in the area. inGRAVITAS-2 also focuses on obtaining complementary geophysical data from zone 3.

In summary the plan designed entails different activities onboard:

1. CPTu *in situ* tests.
2. Sediment cores recovery (Vibrocorer/Piston corer) in defined sites.
3. Parametric profiles and multibeam data (simultaneous acquisition).
4. Multichannel seismic (sparker) acquisition.
5. Continuous acquisition of gravimeter and ADCP.

## SOLICITUD DE BUQUE OCEANOGRÁFICO PLAN DE CAMPAÑA

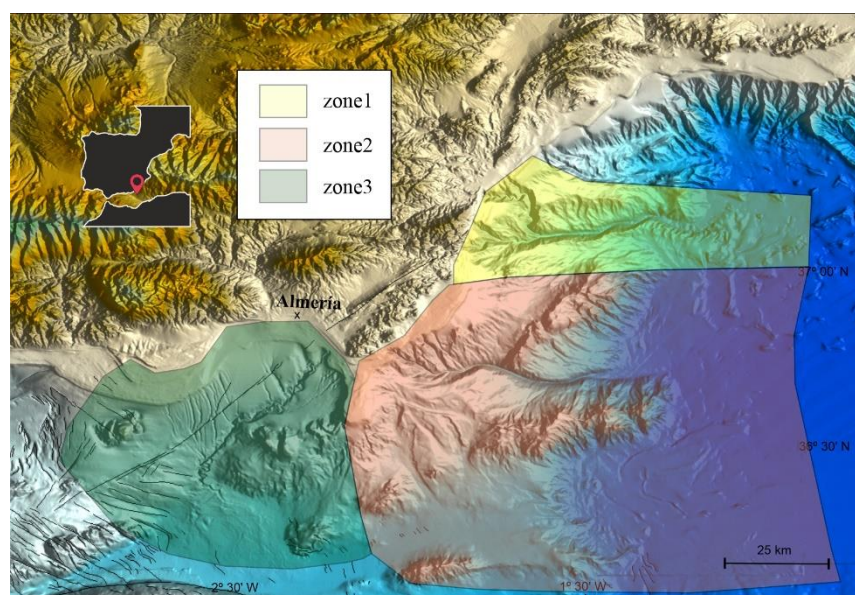
- Mapa general y de detalle de las zonas de muestreo.

The working area of the project is approximately limited by the coordinates  $36^{\circ} 22' 34.8095''$  N /  $3^{\circ} 00' 25.2115''$  W and  $37^{\circ} 08' 39.4738''$  N /  $0^{\circ} 50' 15.4044''$  W covering partially the Gulf of Vera and the adjacent Alboran Sea (Fig. 1). There, three zones (zone 1, 2 and 3) are defined to delimit the different needs of acquisition (during inGRAVITAS-1 and 2 cruises). Zones do not mean a compartmentalization in objectives or expected results.

**Zone 1** is the northern part of the working area and comprises the Almanzora-Alías-Garrucha (AAG) canyon and its margins. This area was mainly surveyed by the FAUCES project, therefore, the inGRAVITAS team has available data of seismic and geophysical records, ROV images, CPTu tests and sediment cores. In this area, regional seismic lines to cover the distal part of the margin that guarantee the correlation with other areas is the only acquisition target.

**Zone 2** covers the southern part of the Palomares margin, from AAG to Cabo de Gata. Is the area where inGRAVITAS project will concentrate a greater effort of data acquisition because it is where there is less data availability. Here geophysical (parametric profiles and bathymetry), seismic profiles, sediment cores and CPTu data are expected to be obtained.

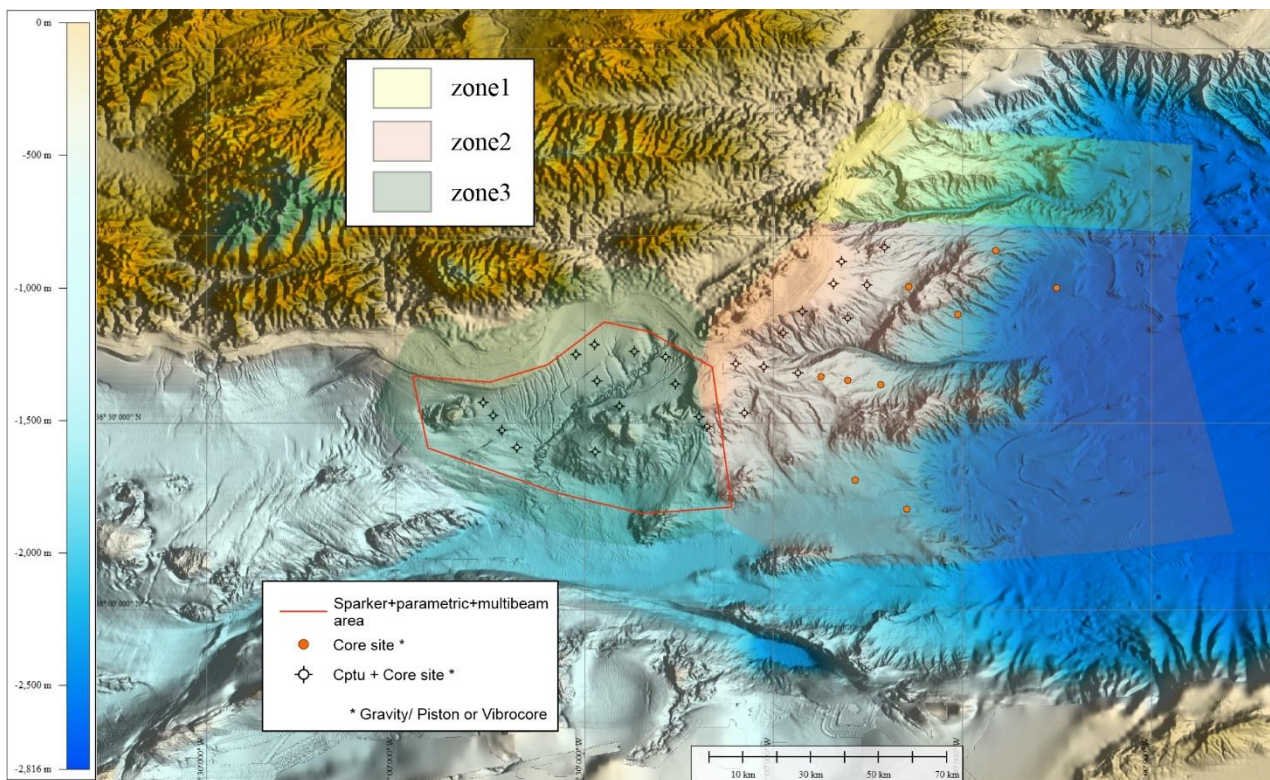
**Zone 3** includes the Gulf of Almeria and adjacent areas of Alboran sea. There is an important collection of seismic profiles available here. Major efforts here will be for sediment cores and *in situ* geotechnical tests during inGRAVITAS-2. Regarding seismic acquisition of inGRAVITAS-1 cruise, it will be focussed on cover the gaps that guarantee the correlation with previous data and a new processing to improve the current profiles resolution. New profiles recorded with a long streamer are needed on the upper continental slope of the Gulf of Almería to perform a processing that allow to remove the multiples and therefore to access a hidden/messy record dominated by mass movements.



## SOLICITUD DE BUQUE OCEANOGRÁFICO PLAN DE CAMPAÑA

**Fig. 1.** General Map of the southern Iberian margins and study areas of the inGRAVITAS project bounded by Palomares and adjacent areas of Alboran continental margins. Three areas (1, 2 and 3) are proposed to acquire data with different density and distribution considering the available data and gaps to be covered.

Acquisition and sampling will be performed from the external shelf/shelf break to the distal margin, from about 100 to up to 2600 meter water depth (mwd). Continental shelf is not an acquisition priority. Sampling sites (piston core/vibrocore and CPTu) planned in inGRAVITAS-2 are very preliminary, since definitive position should be decided after results obtained in the previous cruise inGRAVITAS-1. The geophysical data is concentrated in zone 3 where high-resolution bathymetry is needed to the models planned (Fig. 2).



**Fig. 2.** Cruise plan of inGRAVITAS-2. Preliminary CPTu sites are designed to characterise the areas up to the limit of working depth of the equipment (1000 mwd). Parametric and bathymetry lines (red area) are also planned through the zone 3. Lines will be planned after inGRAVITAS-1 results are analysed.



## SOLICITUD DE BUQUE OCEANOGRÁFICO PLAN DE CAMPAÑA

- Tabla con coordenadas de las estaciones o del principio y final de las líneas o lances. Incluirá la profundidad de las estaciones o cualquier otro detalle de referencia. En el caso de campañas en las que los puntos de muestreo no se puedan definir a priori, descripción detallada de la zona de trabajo, así como del tipo de maniobras y operaciones previstas.

Sediment and geotechnical sampling of inGRAVITAS-2 will be performed in sites to be determined after the TOPAS profiles recorded during inGRAVITAS-1. Sites for CPTu tests will be located at 1000 maximum mwd and across the zones 2 and 3. Preliminary, environmental based, potential sites are selected. Each site is candidate for sampling 1 to 2 sediment cores and one CPTu test (where the range of depth is appropriate):

| CPTu+ CORE SITES IN ZONES 3 AND 2 |               |               |           |
|-----------------------------------|---------------|---------------|-----------|
| SITE ID                           | Longitude     | Latitude      | Depth (m) |
| 1                                 | -2.7659347598 | 36.5543818559 | 371       |
| 2                                 | -2.7389458466 | 36.520139222  | 669       |
| 3                                 | -2.7169111170 | 36.4816589511 | 816       |
| 4                                 | -2.6773061045 | 36.4344101138 | 980       |
| 5                                 | -2.677306104  | 36.6831629293 | 209       |
| 6                                 | -2.4643492106 | 36.6124082875 | 424       |
| 7                                 | -2.4051704492 | 36.5448325643 | 604       |
| 8                                 | -2.4691114328 | 36.4227131015 | 915       |
| 9                                 | -2.4713438053 | 36.7094325606 | 190       |
| 10                                | 2.3656045205  | 36.6915574294 | 231       |
| 11                                | -2.2840139254 | 36.6767948188 | 303       |
| 12                                | -2.2573837506 | 36.6038597015 | 434       |
| 13                                | -2.1944673130 | 36.5166205049 | 433       |
| 14                                | -2.1733226602 | 36.4910629981 | 736       |
| 15                                | -2.0740112372 | 36.5266116811 | 990       |
| 16                                | -2.0982484488 | 36.6584967329 | 377       |
| 17                                | -2.0234342871 | 36.6504424301 | 696       |
| 18                                | -1.9331141184 | 36.6347475040 | 917       |
| 19                                | -1.9728927574 | 36.7412589356 | 466       |
| 20                                | -1.9214098248 | 36.7980242502 | 345       |
| 21                                | -1.8011584637 | 36.7798168412 | 963       |
| 22                                | -1.8397387757 | 36.8722714828 | 356       |
| 23                                | -1.7509667269 | 36.8696510546 | 683       |
| 24                                | -1.7049766296 | 36.9694533769 | 851       |

## SOLICITUD DE BUQUE OCEANOGRÁFICO PLAN DE CAMPAÑA

| CORE SITES IN ZONES 3 AND 2 |               |               |           |
|-----------------------------|---------------|---------------|-----------|
| SITE ID                     | Longitude     | Latitude      | Depth (m) |
| 1                           | -2.0994256723 | 36.4294102791 | 1315      |
| 2                           | -1.9372888645 | 36.4738855768 | 1368      |
| 3                           | -1.7842958807 | 36.3467525417 | 1875      |
| 4                           | -1.6470080005 | 36.2683200317 | 2045      |
| 5                           | -1.8739325492 | 36.6220658117 | 1042      |
| 6                           | -1.8034050700 | 36.6132488445 | 1298      |
| 7                           | -1.7166690367 | 36.6014422228 | 1531      |
| 8                           | -1.6417733939 | 36.8629993204 | 995       |
| 9                           | -1.5114717071 | 36.7887381417 | 1967      |
| 10                          | -1.4116154450 | 36.9594725303 | 1931      |
| 11                          | -1.2508544252 | 36.8596166683 | 2539      |

Parametric and bathymetry lines (Fig. 1; red area) are also planned through the zone 3. Lines will be planned after inGRAVITAS-1 results are analysed, although a potential area of 4700 sq km can be surveyed.

- Requerimiento detallado de apoyo por parte de la tripulación para las maniobras de cubierta. En el caso de fondeos u otras maniobras no habituales, aportar el máximo detalle sobre la instrumentación y sobre la propuesta de maniobra.

Not special support is expected. The help required from the crew is the common in an average cruise of marine geology for deploy and recovery sediment core equipments. CPTu deploy and recovery will be carried out by CPTu technicians.

- Instrumentación del buque o sistemas portátiles que se emplearán, tanto del sistema nacional, como del propio equipo científico, así como los requerimientos del personal técnico necesarios para la campaña.

### *Ship's equipment list requested:*

Atlas Parasound P-35/ TOPAS  
Multibeam Atlas Hydrosweep Fansweep 20  
Multibeam Atlas Hydrosweep DS-3 1° × 1° (Deep waters)  
XBts  
Caris software  
EA 600 sounder  
KongsbergMaritime EK 60  
Piston Corer



## SOLICITUD DE BUQUE OCEANOGRÁFICO PLAN DE CAMPAÑA

Gravity Corer, Vibrocorer  
ADCP OceanSurveyor 75-150 kHz  
Gravímetro Micro-g LaCposte Air-Sea system II  
GeoEel streamer (48 ch), Eiva, Delph.  
High resolution multichannel seismic system. Sparker.

All the equipment listed is managed and supported by the UTM-CSIC

- Requerimiento de apoyo técnico para asegurar el desarrollo de la campaña.

The equipment requested for inGRAVITAS-2 cruise has to be linked to the technical support of: 4/5 engineers, 2 seismic 2 electronic-acoustic and 2 for data and communications.

- Personal científico o técnico que embarcará y en su caso, referencia a su responsabilidad en relación con las maniobras o sistemas de buque que se emplearán.

The 24/24h working days needs to be covered by 3 shifts of at least 4 scientists each one. It results in 12-13 people to what must be added 3 CPTU's technicians. Scientific team will cover during shifts the monitoring and quality control of acquisition and will process sediment cores for their storage in the best conditions possible.

- Reactivos y materiales peligrosos que se plantea embarcar.

Not aplicable

- Incluir el plan de trabajo diario de campaña, con el detalle de las maniobras y operaciones previsto.

| inGRAVITAS-2 activity |                                          |                        |
|-----------------------|------------------------------------------|------------------------|
| Day                   | 08-20h                                   | 20-08 h                |
| 1                     | Transit to Zone 2. Multibeam calibration |                        |
| 2                     | CPTU                                     | Sampling               |
| 3                     | CPTU                                     | Multibeam              |
| 4                     | CPTU                                     | Multibeam / sampling   |
| 5                     | CPTU                                     | Multibeam / sampling   |
| 6                     | CPTU                                     | Multibeam / sampling   |
| 7                     | CPTU                                     | Multibeam / sampling   |
| 8                     | CPTU                                     | Multibeam / sampling   |
| 9                     | CPTU                                     | Multibeam / sampling   |
| 10                    | CPTU                                     | Multibeam / sampling   |
| 11                    | CPTU                                     | Multibeam / sampling   |
| 12                    | CPTU                                     | Multibeam / sampling   |
| 13                    | CPTU                                     | Multibeam / sampling   |
| 14                    | CPTU                                     | Multibeam / sampling   |
| 15                    | CPTU                                     | Transit and demob CPTU |

## SOLICITUD DE BUQUE OCEANOGRÁFICO PLAN DE CAMPAÑA

|    |                                |           |
|----|--------------------------------|-----------|
| 16 | Transit and sampling           | Multibeam |
| 17 | Sampling                       | Multibeam |
| 18 | Sampling                       | Multibeam |
| 19 | Sampling                       | Multibeam |
| 20 | Sampling                       | Multibeam |
| 21 | Sampling                       | Multibeam |
| 22 | Sampling                       | Multibeam |
| 23 | End of work, transit and demob |           |

- Alternativas en caso de mal tiempo, que puedan afectar a los muestreos previstos.

In the case of weather or sea conditions interfere with the normal course of acquisition, the team will adapt the plan avoiding techniques such as CPTu or corer deployment. Logistical aspects (deploy, recovery, transits, breakdowns, weather) have been accounted based on the experience of the team. The plan can be changed for short periods of time. Sparker equipment is also considered a spare for inGRAVITAS-2 in case that sampling gears (vibrocorer or piston corer) have technical problems.

- Plan de contingencia para el caso en que la campaña se retrase o se anule y afectación en los objetivos del proyecto en los escenarios alternativos

inGRAVITAS project is based on the acquisition of high-resolution data. The general working plan of the project has been designed to restrain the effects of potential delays in the cruises programming but the cruises are essentials and cannot be cancelled.

El/la IP contemplará que la información del plan de campaña que se incluya en este documento, definirá el contexto máximo de la campaña, en términos de área de trabajo, duración e instrumentación que se pondrá a su disposición en caso de ser aprobado el proyecto.

**NOTA.** - El/la IP y/o jefe/a de campaña serán, en su caso, responsables de la tramitación inicial de los permisos de trabajo en aguas extranjeras o en zonas protegidas.

#### 4. RESUMEN DEL PLAN DE CAMPAÑA (máximo 10 líneas).

The **project inGRAVITAS** propose to address the **submarine landslide hazard analysis and quantification** through the study of the slope characteristics and triggering factors (e.g. sources) in an extent of the S Iberian margin. Acquisition during inGRAVITAS-2 will be specially addressed to a sedimentary, *in situ* geotechnical, stratigraphic (TOPAS) and geomorphological (multibeam) characterization of an area approximately limited by the coordinates 36° 22' 34.8095" N/ 3° 00' 25.2115" W and 37° 08' 39.4738" N/ 0° 50' 15.4044" W, covering partially the Gulf of Vera and the adjacent Alboran Sea. The cruise plan is designed to fulfil the gaps of incomplete, inaccurate or totally absent data needed to fully understand the instability processes in the area.