GS-One Geophone

REDUCE COST, IMPROVE CREW EFFICIENCY, INCREASE S/N

GEOSPACE ENGINEERING RESOURCES INTERNATIONAL, INC.

GEOSPACE Technologies

GS-One Geophone

GS-One Sensitivity

The patented* GS-One, single element geophone is designed to be comparable to the output sensitivity of a parallel/series 3x2 or a 6x1 element array while exhibiting reduced cost and weight. It also has low distortion, yielding a high signal-to-noise ratio and good signal fidelity.

The improved sensitivity, greater than 2 volts/inch/second, makes this single element design compatible with the latest 24-bit data acquisition systems' capabilities to record the extended dynamic range that this element offers.

Design Configurations:

- Conventional 3-C - (three Cartesian ($V/H_1/H_2$) geophone design).
- Galperin – three Galperin configured geophones.

Sensitivity & S/N:

The GS-One is the best geophone to be used for single geophone per channel recording because of its high transduction constant (GS-One transduction constant is 0.051, compared to 0.025 to 0.037 *V/ips/SQRT(Ohm)* for most popular geophones**).

- Higher voltage sensitivity than any other geophones with the same coil resistance.
- In practical application the GS-One will provide better signal to noise ratio and will detect a smaller signal than most popular geophones

Damping:

The GS-One produces the ideal 70% damping without the use of an external damping resistor when the input resistance of the recording system is 20K Ohm.

Desirable Survey Characteristics:

Offers close tolerances, high spurious and low distortion characteristics that are desirable for seismic surveys.

** US Patent 8,098,546*

***The transduction constant Kg for geophone is G = Kg * SQRT(Rc)*
If G is V/ips the Kg will be V/ips/SQRT(Ohm)
If G is V/m/s then Kg will be V/m/s/SQRT(Ohm)
In our brochure, .051, .025 and 0.037 are English System constants, therefore the unit for Kg is V/ips/SQRT(Ohm).

GS-One 3-C with three Cartesian ($V/H_1/H_2$) geophone design and aluminum housing.

GS-One 3-C Conventional or Galperin geophone design in composite case with T-2 Tripod base

**US Patent 8,098,546*

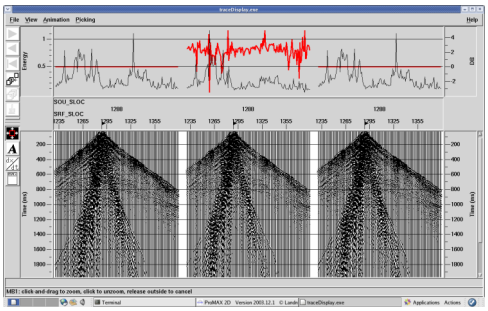
GS-One 3-C with three Cartesian ($V/H_1/H_2$) geophone design in the GS-3C land case

GS-One 3-C with three Galperin geophone design in stainless steel case

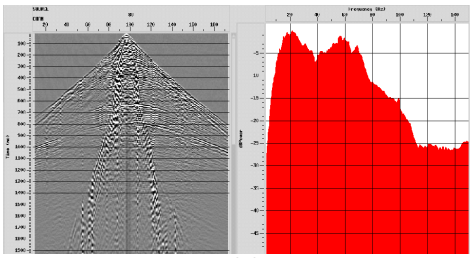
GEOSPACE ENGINEERING RESOURCES INTERNATIONAL, INC.

GEOSPACE Technologies

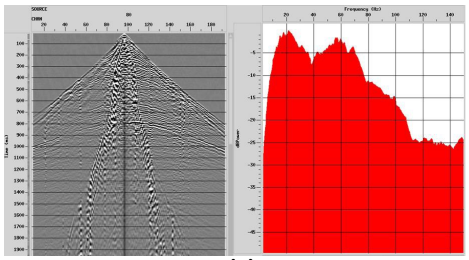
Pacific Rubiales Energy, an operator with projects in Colombia, Peru and Guatemala, recently conducted a side-by-side 2D field test comparing the single element GS-One geophone to a conventional 6x1 geophone string. In a 10-day test in Columbia's Llanos Basin, two 9.5km lines were deployed in parallel, one using GS-One geophones and the other using conventional six string elements.



(a) (b) (c) (1)



(2)



(3)

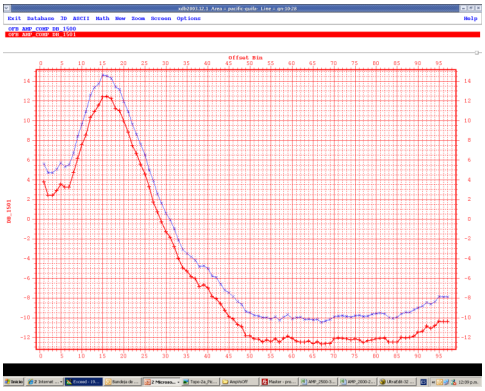
(1) *Raw records corresponding to shot point 1288 and the energy level of each trace. (a) 6 x 1 geophone array (b) GS-One (c) GS-One scaled*

(2) *Raw record with six geophones. To the right their frequency spectra.*

(3) *Raw record with one GS-One geophone. To the right their frequency spectra.*

(4) *Average amplitudes for the seismic traces. The blue curve corresponds to the record with six geophones and the red curve to the GS-One geophone. 1500 – 2000 ms.*

(4)



Pacific reported a wide range of cost and operational advantages of the GS-One geophone based on the field test:

Smaller crews: The GS-One required less than half the crew of a conventional line, an estimated 21-person crew vs. 58 for laydown.

Safer operations: Fewer people working a survey and exposed to risks, less weight for crews to carry, and fewer vehicle trips will reduce the potential for injury on future Pacific projects.

Reduced transport costs: Pacific estimated that without the heavy cabling and extra weight of the conventional system, fewer vehicles and delivery trips would be needed, thereby reducing costs and risk – especially in dense terrain or remote regions where helicopters or barges would be utilized.

Improved survey parameters and quality
The GS-One system allowed for improved bin size and coverage by enabling flexibility of distribution between source and receiver.

Equivalent data quality
Pacific's results showed that constant amplification for the GS-One is 85.8 V/m/s vs. 125 V/m/s for a conventional string, a relationship that makes it possible to replace conventional strings with a single GS-One element without affecting the quality of the seismic data. In addition, Pacific found that the preliminary and final seismic sections PSTM (prestack time migration) for both types of receptors was effectively equivalent.

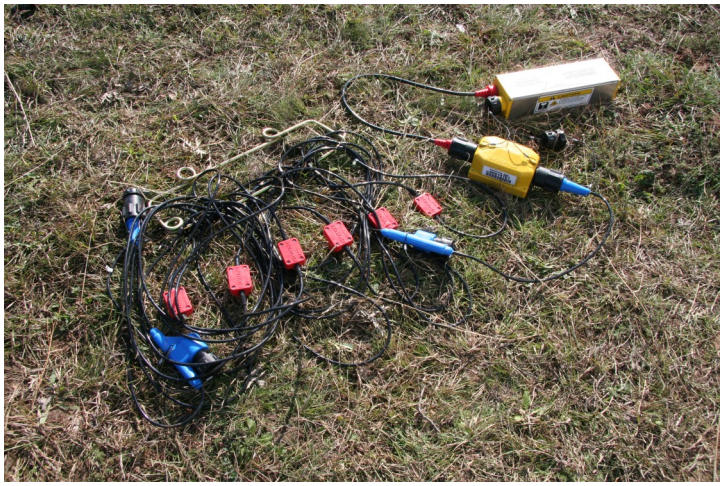
Lower repair and troubleshooting costs
Pacific's analysis indicated that with less cabling material to be damaged or malfunction, the GS-One would reduce repair costs and potential delays.

Results
Based on its findings, Pacific Rubiales Energy has now approved the GS-One geophone for its Colombian seismic projects for the rest of the year. Bidding contractors can now incorporate GS-One technology into their proposals, enabling more competitive job costs for everything from feeding crews to fueling vehicles. "Based on this test, we feel very comfortable that the GS-One will provide us with the data quality we want and allow us to reduce survey costs – especially in challenging terrain," says Rober Yibirin, Geophysical Operations Manager at Pacific Rubiales Energy. "Comparing these technologies head-to-head was a very valuable exercise for our future Colombian operations."

GS-One

The following table shows the comparison between the GS-One and 3x2 and 6x1 element arrays.

	DC Resistance	Fn	Damping	Sensitivity	Distortion
GS-One	**1800**	**10**	**0.7**	**2.18**	**0.05% (typical)**
3x2	425	10	0.7	1.5	0.1%
6x1	1700	10	0.7	3.0	0.1%



The GS-One sensitivity is <u>4.36 times</u> that of a conventional geophone.

Greater sensitivity than a 3x2 element geophone array.

GEOSPACE Technologies

7007 Pinemont Drive • Houston, Texas 77040 USA
www.geospace.com
Tel: 713.986.4444 • Fax: 713.986.4445

GEOSPACE ENGINEERING RESOURCES INTERNATIONAL, INC.

Regional Offices

Geospace Technologies, Canada
2735 - 37th Avenue N.E.
Calgary, Alberta, Canada T1Y 5R8
403 250-9600

Geospace Technologies, Eurasia
Kirovogradskaya, 36
Ufa, Baskortostan, Russia 450001
011 (7) 3472 25 39 73

Geospace Technologies, China
Room 700, 7th Floor, Lido Office Tower, Lido Place
Jichang Road, Jiang Tai Road, Beijing, 100004, P.R.China
011 (86) 10 6437 8768

Geospace Engineering Resources International (GERI), UK
F3 Bramingham Business Park, Enterprise Way, Luton
Bedfordshire LU3 4BU, England
011 44 (0) 7775 688 467