# Smartphone Prospecting Tools

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Don't leave home without it. Smartphones can be the Swiss Army Knife of field tools for prospectors and geologists. The typical smartphone can now perform a range of communication, data capture, storage, display and sensing tasks useful in the field. Even when outside mobile network coverage most field related tasks can be accomplished. In this discussion all applications (apps) and capabilities are assuming the user is beyond network coverage while in the field. The apps described here are running on my Samsung Galaxy S2 Android device but most are also available for iPhone or an iPhone app delivering similar functions will exist. All but one of the apps discussed here are the "Lite" or free version.

Smartphones have a number of built in sensors that have facilitated the development of a wide range of useful apps. Sensors and capabilities vary by phone make and model as well as operating system but typically include;
- cell phone, WiFi and Bluetooth,
- audio recording and voice recognition,
- camera (photos and video),
- GPS and aGPS capabilities,
- compass,
- removable mass storage,
- removable rechargeable battery,
- magnetometer,
- 3-axis gyroscope,
- 3-axis accelerometer.

(see http://en.wikipedia.org/wiki/Comparison_of_smartphones)

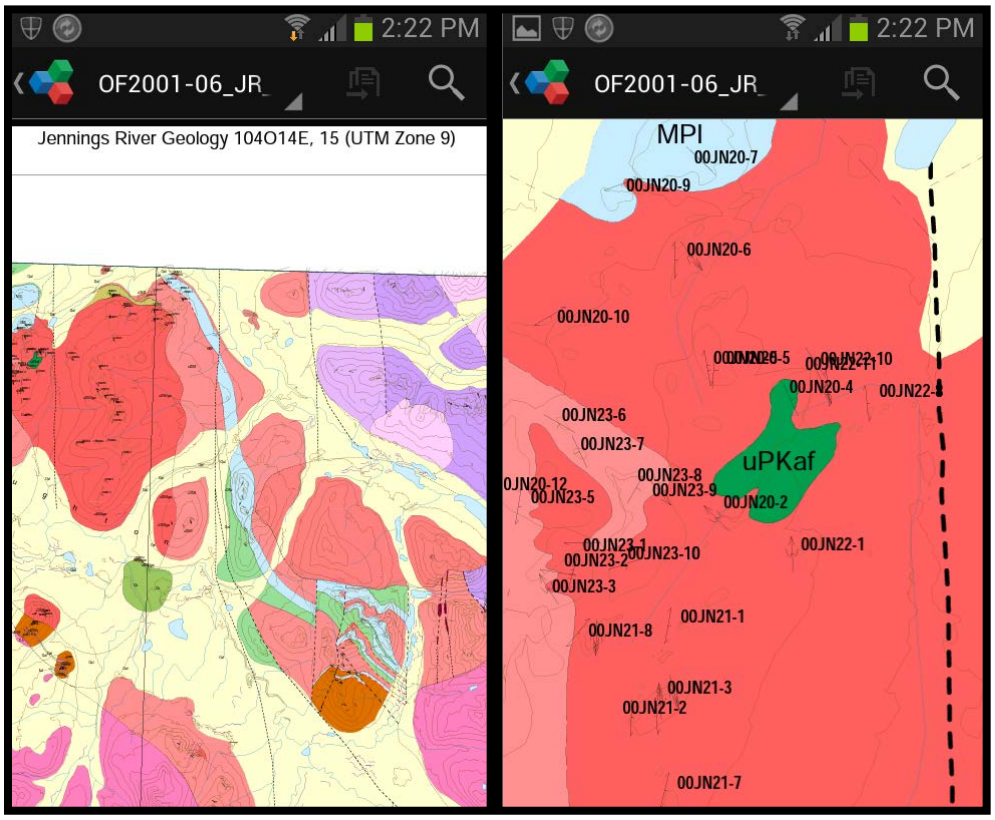
App developers have utilized these sensors, individually or in combinations to build a vast array of apps, many with direct applicability to the needs of a field geologist/prospector. We will take a look at several apps ranging from mundane, but powerful, file handling tools to geophysical sensors. Just like a Swiss Army Knife, smartphones can perform many tasks. It's important to note that they are not usually better than high quality dedicated devices at specialized tasks but have the advantage being available in a small always at hand device.

For field work the ability to change batteries and swap out memory cards is a significant benefit. Power consumption on some models can be significant depending on the sensors in use. A spare battery or two can provide for a fully powered day in the field. Most phones come with reasonable built in memory capacity and/or the ability to use microSD memory chips that can easily be swapped in and out. MicroSD memory chips with 32 GB of memory are sufficient to hold a large property database (containing many geological and assessment reports, reference materials and full airphoto coverage) as well as providing a backup capability while in the field. ZipLock™ sandwich bags provide inexpensive and efficient dust and moisture protection and even emergency floatation capability. Connection to the internet through free WiFi is only required to preload the

device with data prior to venturing offline. After that one need never connect through a cell phone network.

OFFICE TOOLS

A number of app suites provide the ability to view and edit common data files such as Excel, Word, PowerPoint and PDF. These apps along with a large storage capacity allow a complete project reference library to be carried on the mobile device. Property reports, exploration plans, assay certificates, assessment reports, manuals, procedure documents, PDF maps and government geology reports are examples of handy documents to have available in the field. Apps such as ***CamScanner*** use the smartphone's camera to scan and capture hardcopy material into a PDF format for access in the field.



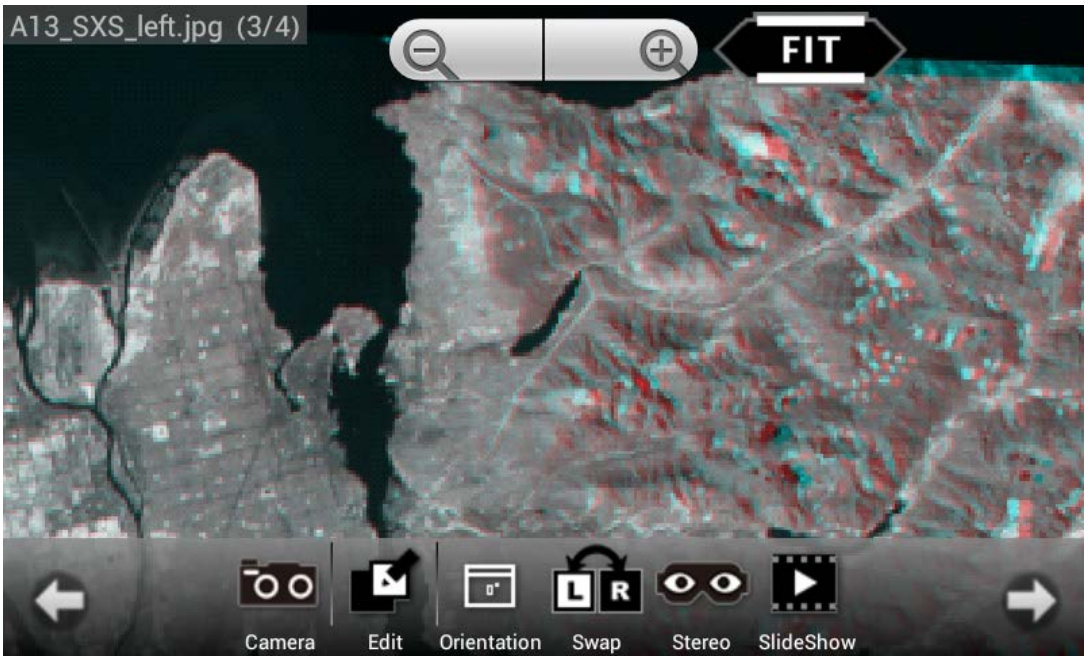

**Screen capture view of large format PDF geology map. Right panel is an enlargement of NW corner of left panel.**

CAMERA

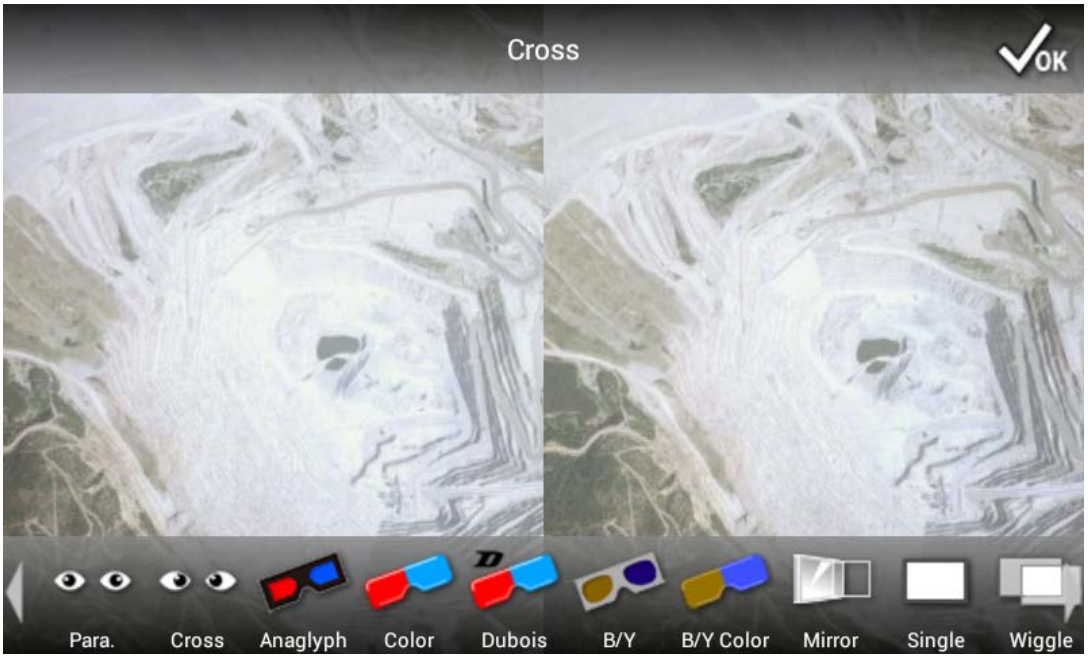
The camera(s) included on virtually all mobile devices are extremely versatile and when combined with some of the other sensors can provide very useful capabilities. While the optics of mobile device phones are not equivalent to a good quality camera they are usually sufficient for typical field photography. Specialized apps allow the location, time, elevation and orientation of each picture to be recorded. The ability to GeoTag a picture (embed latitude and longitude) has been available for many years but now apps allow one

to record the elevation, viewing direction, pitch and yaw of the camera either on the picture or in a file.

One can even take stereo pictures. Apps such as ***3DSteroid*** allow the user to take two pictures from different angles and generate an anaglyph image that can be viewed with 3D glasses to provide a stereo view. In addition, this app allows the user to import stereo image pairs and view as anaglyph images. One could take pictures of an existing pair of airphotos, download ASTER stereo pairs from the MapPlace or obtain high resolution images from GeoBC. If you forget your anaglyph glasses you can view the scene with crossed or parallel eyes to see stereo in true colour. The user can zoom and pan around the area with stereo coverage. For long term viewing one can use a pocket stereoscope over the phone.




**Anaglyph view of ASTER stereo pair of Vancouver downloaded from the MapPlace. View with red-cyan glasses.**




**Cross-eyed stereo view of a Highland Valley pit made using free downloaded colour airphotos from GeoBC. Cross your eyes to view in stereo.**

The camera also can act as a magnifying glass with light source easing view of small items. App ***Magnify*** provides about 5X power viewing or photographing but if higher magnification is required a hand lens can be held in front of the camera with an elastic band.

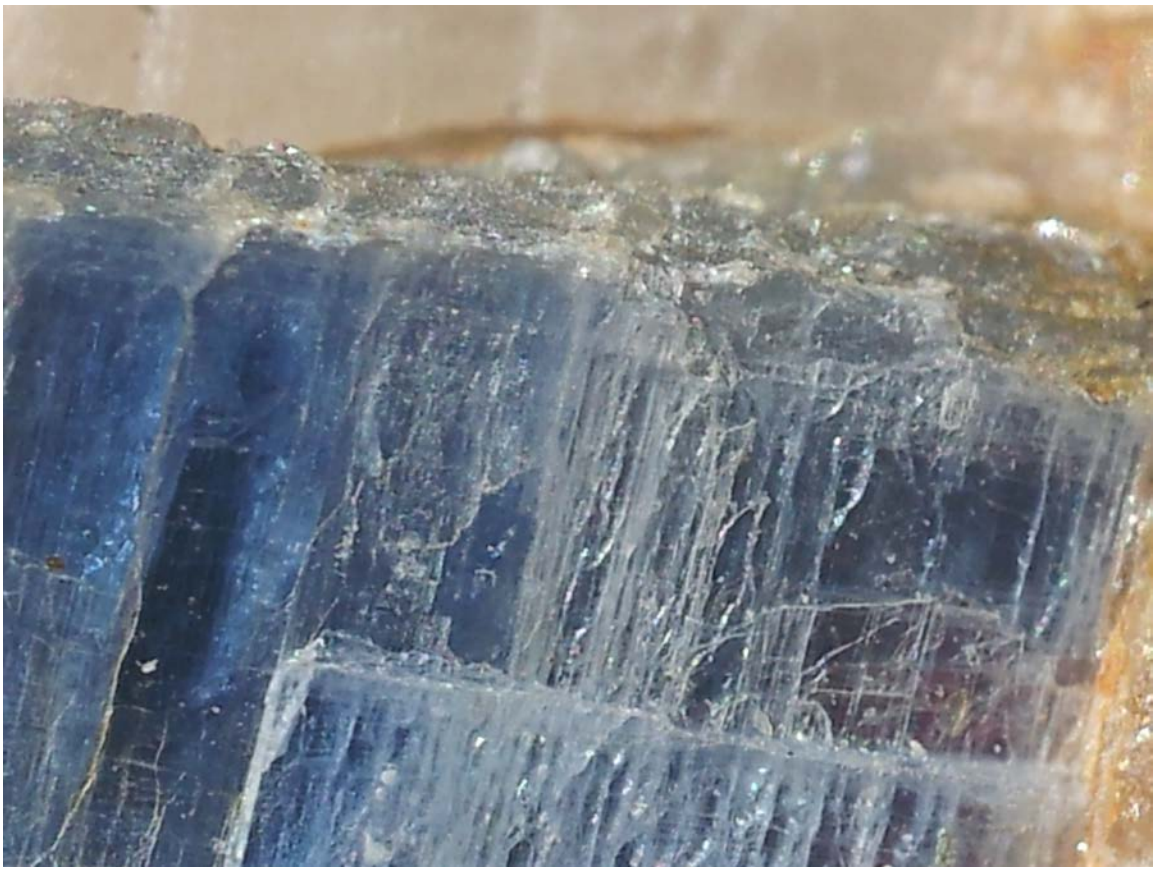


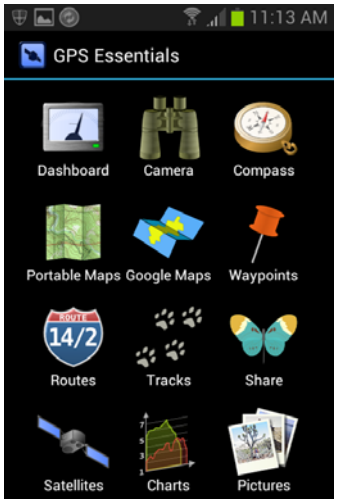
**Photo of Kyanite with 10X hand lens held over camera using *Magnify* app. Field of view is 7 mm wide.**

Other apps combine the camera with sensors such as GPS and gyroscope to provide range finding and survey style capabilities. Apps are available to calculate distances to objects of known height or width such as stadia rods or calculate the dimensions of an object at a known distance using the camera interface.


***Smart Distance* screen capture showing example of measuring distance utilizing an object of known height, in this case a Yamayo Model C Mini-Rod pocket stadia.**

**GPS**

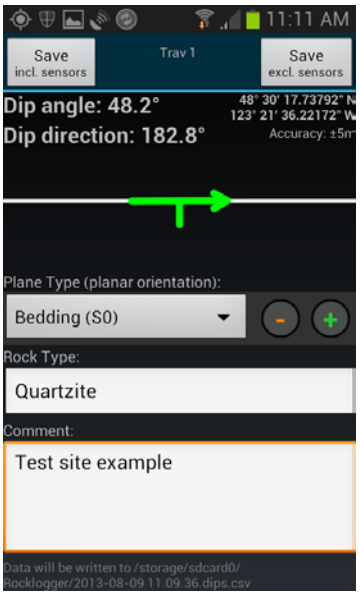
The built in GPS sensor allows for positional information to be incorporated in any type of app. The GPS sensor in a smartphone rivals the traditional handheld GPS with respect to satellite acquisition and positional accuracy. If the phone has aGPS and is within mobile network coverage it may have superior accuracy and availability. A variety of apps duplicate the traditional functions provided by stand alone GPS units and other apps augment these functions with a wide variety of additional capabilities.



**Screen capture of *Essential GPS* option page.**

COMPASS

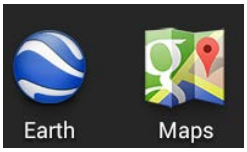
Many apps are available to take advantage of the compass housed in many smartphones. A variety of user interfaces allow one to do most anything one would with an classic compass. A very useful app is ***Rocklogger*** which mimics a structural compass allowing structural orientations to be rapidly collected along with the GPS coordinates, rock type and notes. Photos or magnetic field strength can also be captured within the same file structure. Rock type and notes can be entered verbally with the phone's built-in voice translator. The resulting data can be plotted on Google Maps with recorded attribute data displayed in information balloons. The Pro version ($9.30) allows the data to be edited, plotted on a stereonet and exported to KML format for viewing in Google Earth. The traverse data is stored in a CSV file that can be easily read by Excel or most GIS systems.




***Rocklogger* screen capture of typical structural orientation entry page.**

## MAPS

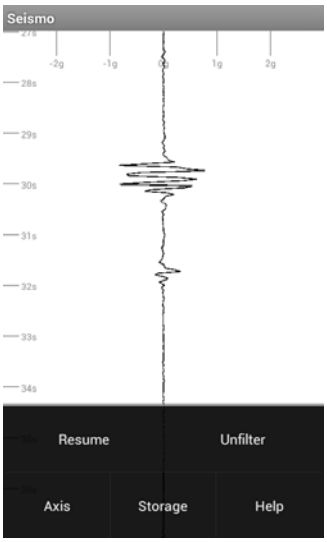
There are a number of apps that display maps with a variety of typical navigation options. Some of these apps tap into specialized base maps while others provide generic street and/or image bases. The ubiquitous ***Google Maps*** app is an excellent product that is available on most smartphones. ***Google Earth*** is also available for most smartphones and provides a 3D viewing option. Both of these apps can make use of cached data for offline use. All one needs to do is set the largest possible cache size and then capture the data for the area of interest before venturing offline. Apps such as ***Rocklogger*** utilize Google Maps for plotting so it can make use of the cached map data as well.




***Google Earth* and *Google Maps* can be used offline with cached data.**

## Seismic Recorder

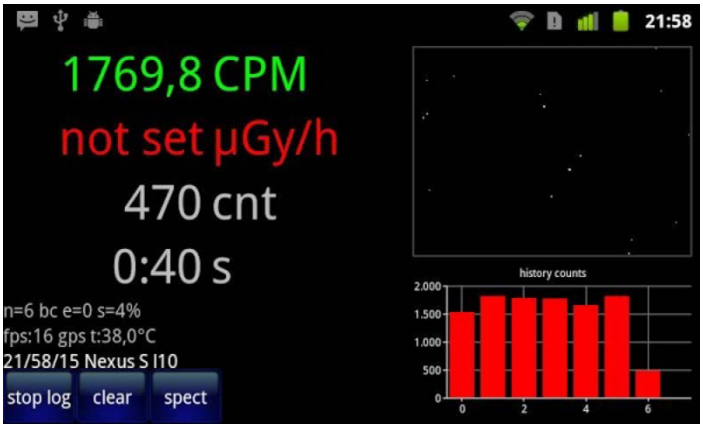
The embedded 3-axis accelerometer in many smartphones allows apps to measure vibrations such as seismic waves. The app ***Seismo*** displays a vibration chart and records the acceleration along each of the three axes 30 times a second. This recorded information can be exported to an Excel compatible file for later viewing or processing. While not directly applicable to prospecting it may be handy to record other events such as ice falls or tremors related to slope stability issues.




***Seismo* screen capture of chart recording and options menu.**

## Radiation Counter

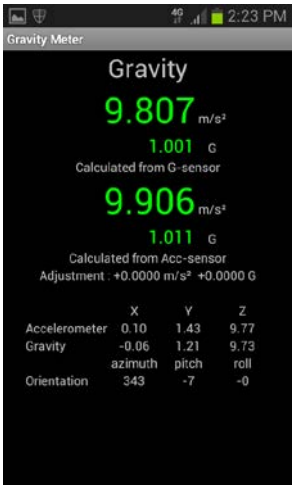
This app, ***Radiation Counter***, is not free ($4.58) and is the only purchased app discussed here. While not tested against a known radioactive source it appears to work well and the documentation included with the app and on the related web site suggests it is worth having available as a quick and dirty testing option. Their web site documents the smartphone cameras that have been tested and their rating with respect to this app. By placing one or two layers of black electrical tape over the camera this app detects energy particles with enough energy to get through the tape and be sensed by the camera's  solid state sensor. Unfortunately, most such apps are gimmicks or radiation database access tools but this one seems to be legitimate.




***Radiation Counter* screen capture showing sensing page.**

## Gravity

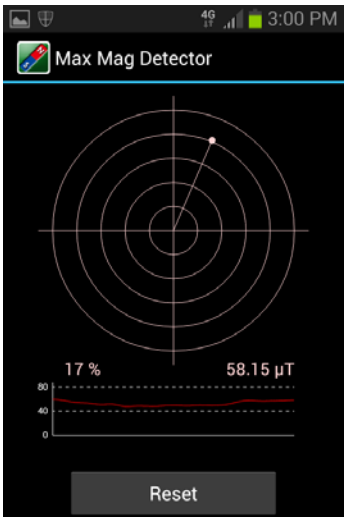
The gravity measurements possible with the current smartphones may not have the sensitivity required for detailed work but it provides an interesting capability that may prove useful in certain circumstances. ***Gravity Meter*** reports values with a resolution of about .001 m/s$^2$ (100 mGal) but accuracy may be more like .05 m/s$^2$. Typical gravity maps have a scale range of about 200 mGal. It is very likely that the sensitivity of accelerometers will continue to increase and may be capable of creating a rudimentary relative gravity survey in a pinch. In the mean time it is still interesting to experiment with this sensor.




***Gravity Meter*** **screen capture showing measured gravity values for Victoria, BC.**

**Metal Detector/ Magnetometer**

Many apps are available to measure the magnetic field around the smartphone and the proximity of metal. The app ***Max Mag Detector*** can switch modes between these two functions. Many of the apps have audible or vibration warning signals to notify the user when certain conditions are met. The smartphone magnetometer reports values in microTeslas. Like the gravity sensor the magnetic sensor reports values about 3 orders of magnitude lower than commonly reported on magnetic anomaly maps. However, the ability to sense changes in magnetic field strength and direction can prove useful in some prospecting situations.




***Max Mag Detector* screen capture displaying the metal detector mode.**

In conclusion, this discussion has looked at some of the many capabilities a smartphone can provide the field geologist/prospector in addition to the ability to communicate with the outside world through a cell network if in range or with the aid of SPOT Connect through a satellite network if offline.

Apps mimicking traditional PC data storage and viewing functions provide anytime anyplace access to tradition exploration type information such as; reports, maps and imagery. Other common apps provide real time location awareness information through GPS and Google combinations. Apps are available to capture a wide variety of field data. The sensors embedded in the phone also provide the means to measure some common geophysical parameters.

With each new version of smartphones the quality of their sensors improves and the app developers are quick to incorporate these capabilities into new apps, so their usefulness in the field can only continue to grow.