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Soil gas survey in the Ilan Plain, NE Taiwan and its tectonic implications

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The Ilan Plain, northeast Taiwan, which is located at the western tip of the Okinawa Trough, undergoes extension and left-lateral slip. There may exist a few suspected faults and fractures underneath the Ilan Plain related to back-arc spreading of the Okinawa Trough. However, theses fault traces have not been well understood due to the thick alluvial sediments. Previous geochemical and geophysical research suggested melting features and igneous intrusive rocks resulting from the opening of the Okinawa Trough.
The soil gas method is a useful tool to recognize the fractures and fault zones of which provide the pathways for migration of fluid from deep source toward surface. This study attempts to utilize soil gas method to survey the Ilan Plain. We measured carbon dioxide flux, helium concentration, radon concentration and gas chemical compositions to identify the distribution of faults/fractures and to verify the influence of spreading of the Okinawa Trough to the plain.
The results show that soil gas concentrations decrease from east to west, which seems to relate to the progressive westward extension of the Okinawa Trough. Besides, the spatial distribution of anomaly sites corresponds to the specific faults and fractures pointed out by previous studies. Higher soil gas concentration appears in the southern part of the plain, where seismic activities occurred intensively and frequently, implies the existence of fault/fractures and the invasion of magmatic fluids beneath the Ilan Plain.
Carbon isotopic compositions of soil carbon dioxide indicate a mixture of organic and magmatic source. Based on the radon and carbon dioxide concentration, we propose two potential gas reservoirs. One is the deep source, showing good correlation with radon and carbon dioxide concentration. The correlation also suggests that carbon dioxide is the carrier gas of radon being transported along the faults and fractures in the Ilan Plain. The other one may be the in-situ radon source, which is mostly observed in the northwestern flank of the plain. Nevertheless, radioactive isotopes in soil samples should be undertaken to further explore this hypothesis.
Results of continuous monitoring indicated temporal variations of helium, radon, and carbon dioxide concentration, which may relate to tectonic activity or seismicity. However, further observation and monitoring is needed.